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PRINCIPAL INVESTIGATOR: Russ Zajtchuk, M.D.

CONTRACTING ORGANIZATION: Rush-Presbyterian-St. Luke's Medical Center
Chicago, IL 60612

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Russ Zajtchuk, M.D.

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Rush-Presbyterian-St. Luke's Medical Center
Chicago, IL 60612

E-Mail: rzajtchu@rush.edu

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13. ABSTRACT (Maximum 200 Words)
This pilot program is funded by the Army Medical Department (AMEDD) and mandated by Congress to demonstrate the feasibility of establishing a Department of Defense (DoD) Telemedicine Information Analysis Center (TIAC). The TIAC core capabilities include applying the science of classification (taxonomy) to telemedicine to identify key words, creating a bibliographic database using these key words, providing analyses by subject matter experts for clinical and technical queries, preparing reports and disseminating information via a public TIAC web site, and performing technical area tasks (TATs). A baseline TAT is conducted that reviews past AMEDD funded research and development projects and evaluates their utility to programmatic development and utilization within medical specialties. Although conceived as a DoD resource, the TIAC can serve as a global resource for the telehealth scientific community by, developing technical and clinical standards, enhancing the productivity and effectiveness of researchers and clinicians, identifying best information technology applications for incorporation into main-stream medical practice and business models, and expanding the key words for telemedicine in the National Library of Medicine search engines.

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Telemedicine Information Analysis Center (TIAC)
Final Report
(Including the Fourth Quarterly Technical Report)

1. INTRODUCTION

In 1997 the General Accounting Office (GAO) in a report to Congress recommended that Federal Strategy be developed to guide investments in the field of telemedicine. The report calls on the Department of Defense to help forge a government-wide strategy for using and gauging success of telemedicine technology in the federal area. In 2001 Congress directed DoD to conduct a pilot study to determine the feasibility of establishing a Department of Defense Information Analysis Center for telemedicine with the goal of maximizing return on investment and develop better coordination and exchange of information and analysis of telemedicine projects. This pilot program successfully demonstrated the value of the functions of a Telemedicine Information Analysis Center (TIAC) to research and development decision makers evaluating funded clinical research projects by performing a Technical Area Task (TAT). The web-based TIAC core capabilities include (a) applying the science of classification (taxonomy) to telemedicine to identify key words; (b) creating a relational database of this taxonomy to a bibliographic database using these key words; (c) providing analyses by subject matter experts for clinical and technology queries; (d) preparing reports and disseminating information via a public TIAC web site; and (e) performing technical area tasks (TATs). This pilot study wasconducted by the Center for Advanced Technology at Rush Presbyterian-St. Luke's Medical Center (RUSH) and its consortium partner InteleDatics, Inc.

2. BODY

A. SOW ¶ 4. Deliverables – TIAC Meetings/Teleconferences

1) Meeting at Walter Reed Army Medical Center (WRAMC)
February 20, 2002 (See First Quarterly Technical Report[1])

2) Meeting at the Telemedicine and Advanced Technology Research Center (TATRC)
February 21, 2002 (See First Quarterly Technical Report[1])

3) Meeting at the TIAC, Chicago, IL
March 21, 2002 (See First Quarterly Technical Report[1])

4) Briefing to Commanding General MRMC
June 4, 2002 (See Second Quarterly Technical Report[2])

5) MEDCOM Telemedicine Initiative P8 Meeting
June 5, 2002 (See Second Quarterly Technical Report[2])

6) Teleconference with COTR
September 3, 2002 (See Third Quarterly Technical Report[3])

7) TIAC Briefing to DTIC

Teleconference with DTIC IAC Program Manager 27 February 2003): A meeting was arranged with the Information Analysis Center (IAC) Program Manager (PM) of the Defense Technical Information Center (DTIC), Mr. Ronald E. Hale. Although members of the Rush Consortium traveled to Washington DC for the meeting, a teleconference was held between the meeting members due to inclement weather in the Washington area. The Rush Consortium attendees included Dr. Russ Zajtchuk, Principal Investigator, Dr. Joan Zajtchuk, Technical Area Leader, and Mr. Joseph Petrovic, Co-Director. Mr. Ron Hale, IAC PM, and Ms. Nancy Pfeil of DTIC and Ms. Claudia Oglivie, TIAC COTR, and Conrad Clyburn of the Telemedicine and Advanced Technology Center (TATRC) of the US Army Medical Research and Materiel Command also took part in the teleconference. The objective of the meeting was to explore the process and practicality of transitioning the pilot TIAC study to a fully operational IAC sponsored by DTIC. Dr. Russ Zajtchuk reviewed the objectives and status of the TIAC pilot study and the plans for transitioning to a mature IAC. Mr. Hale discussed recent changes in the funding structure of DTIC managed IACs and their negative impact on establishing new IACs. He also made recommendations on laying the groundwork for DoD's consideration of a new IAC.

8) ATA 2003 8th Annual Meeting and Exposition

A presentation on the TIAC was given at the American Telemedicine Association (ATA) 2003 8th Annual Meeting and Exposition held in Orlando, Florida on April 27-30, 2003. This TIAC presentation was included in the section titled "Tools to Enhance Medical Training and Research." The final manuscript, submitted to the Telemedicine Journal and e-Health for publication, is included in Appendix A. The slides and handouts used for the presentation are included in Appendix B. All figures and tables found in the body of this report are labeled according to that used in Appendix A for the manuscript.

B. SOW ¶ 2.2 Information Processing and Management

1) Information Support System

The development of a rudimentary Information Support System (ISS) was completed during the fourth quarter. The configuration of the completed system is shown in Fig.1 of Appendix A. A bibliographic database, public web site, and project database are included in this ISS to demonstrate proof of concept. The ISS is part of a Secure TIAC Network (STN) that will permit controlled access to files of a sensitive nature that are stored in the TIAC. The access to controlled data is achieved via a virtual private network (VPN) within the STN and Secure Sockets Layer (SSL) pages that require a login for access.

The configuration of hardware and software selected for the STN allows a proof of concept demonstration using commercial-off-the-shelf (COTS) items (See Fig. 3, Appendix A). The VPN provides access at any site for the TIAC staff to the bibliographic database and files and also provides the ability to maintain the web server remotely. A dedicated firewall device connects the TIAC STN to the Internet. This firewall is directly attached to Rush's incoming Internet connection and is completely separate from the Rush Medical Center's hospital network. The infrastructure of the TIAC Network is discussed in Appendix A.

2) Bibliographic Inquiries

a. Bibliographic Database

Early in the program effort was directed toward populating the TIAC bibliographic database using Reference Manager™ as the database application program (See Table 1, Appendix A). The objective of this initial step was to compile a sample listing of references that can be used in testing the query capabilities of a database search. It also served to capture the reference data that is applicable to TIAC information collection requirements.

Two primary sources were used for the collection of references. One source of references was those used in a recent state-of-the-art telemedicine symposium focusing from an international perspective[4]. This symposium involved invited speakers, panel members, and other participants who represented the leaders in experience and achievement in telemedicine/telehealth applications, science, technology, and in telemedicine program and policy development. The second source of bibliographic references used for the TIAC database was PubMed. PubMed, a service of the National Library of Medicine (NLM), provides access to over 12 million MEDLINE citations back to the mid-1960's and additional life science journals. PubMed includes links to many sites providing full text articles and other related resources. Several subsets of the PubMed were searched for references associated with telemedicine where the subsets corresponded to various years in which the references were collected.

b. MEDCOM Project Queries – Demo B

The TIAC can assist MEDCOM researchers and program managers in the future in the following way. As an example, at the beginning of project planning, the principal investigator can complete a bibliographic inquiry form via the public TIAC web page (See Fig. 5, Appendix A) to ask specific bibliographic, technical or clinical questions of the TIAC staff. Questions might relate to defining a specific technology application or infrastructure requirement, completing a search for related clinical applications in other specialties, or previous implementation of a newer technology. The TIAC staff then queries the specific TIAC databases and provides a list of pertinent references and answers to questions that assist the principal investigator in the project planning process. Principal investigators could request a second and third inquiry respectively at the middle and end of the project. This would force the

investigator to incorporate the most recent literature references or results into their project results and recommendations.

The baseline MEDCOM TAT provided the impetus for the TIAC to perform a limited number of retrospective bibliographic queries using MEDCOM FY00 and FY01 projects. This procedure could also be used to perform technical inquiries. This exercise tested the core capabilities of the TIAC ISS and provided information about the breadth and scope of references in the TIAC-generated bibliographic database. This bibliographic search procedure, not a part of the baseline TAT, is described in the following paragraph and the results of the application of the queries is discussed in the baseline MEDCOM TAT, Section 2.D.2.

The objective in performing a query for a given project is to search a database(s) to find all references that will provide the desired information for that project. In order to relate a query or search to a given project and quickly identify the specifications of the query, care must be taken in documenting each query. The following items were recorded for each query or search:

- Date,
- TIAC Program Task (Demo B),
- MEDCOM Project (e.g. FY00-0148),
- Database Source (PubMed),
- Database Title (e.g. TM1999),
- Search Strategy
  - Filename (e.g. DemoB_FY00_0148-01),
  - Structure (field e.g. keyword)
  - Connector (AND/OR/NOT)
  - Parameter (e.g. keyword = asthma AND remote consultation)

The specifications for each search or query performed on the FY00 and FY01 MEDCOM projects investigated are given in Appendix C. The databases used for the projects are all from the PubMed Telemedicine category and the years 1999, 2000, and 2001. These years were chosen since the FY00 projects involve proposals written in 1999, work done in 2000, and final reports prepared in 2000-2001. Therefore, the databases provided references with the most current information for each year and phase of the projects.

A problem was encountered in searching for references due to the lack of alignment between the keywords used by the MEDCOM researchers and those keywords used in the PubMed databases. Table 1 shows the match between keywords used by the MEDCOM researchers and those used in the PubMed 1999 telemedicine database (TM 1999). As can be seen from the table, on the average only 25% of the keywords used by the researchers appear in the database. For example, in the case of MEDCOM Project number 0178 which listed four keywords, only one of those keywords was used in the TM 1999 database. This database contained a total of 1218 keywords. This mismatch of keywords indicates a lack of coordination between the PubMed database parameter selection and telemedicine language used by the researchers. This problem can be addressed by the TIAC as discussed in the Third Quarterly Report (Section 2.B.2.b)[3]. A

work plan has been developed that includes comparing the telemedicine terminology found in the Rush Consortium generated keyword structure as it relates to the MeSH categories in the NLM. The NLM was contacted in the second quarter and a proposal for expanding the MeSH categories through the application of an expanded taxonomy for telemedicine was proposed. However, even with this lack of uniformity with keywords, many appropriate and helpful references were retrieved that provide important information for MEDCOM program managers as well as the researchers

C. SOW ¶ 2.4 Information Dissemination

1) Development of TIAC Public Website

The public TIAC website provides users with easy access to the TIAC resources and provides researchers "one-stop shopping" in obtaining needed assistance in designing new research projects (See Fig.4, Appendix A). The access is nearly universal from any desktop PC using an Internet connection and browser. Since the majority of users have experience navigating the Internet, investment in training and familiarization is kept to a minimum. All security parameters and login confidentiality are administered centrally from the TIAC server. The utility of a TIAC ISS, utilizing a website, shows its value in ease of use that avoids investments in stand-alone infrastructure costs. By logging into the TIAC website with COTS browsers like Internet Explorer™, users can initiate a secure connection to download files or view sensitive information via SSL pages.

Table 1. Keyword Matches Between FY00 MEDCOM Funded Projects and PubMed 1999 Telemedicine Database*

MEDCON Project Number**	Number of Project Keywords	Number of Keyword Matches Between Project and Database	% of Matches
0085	7	0	0
0102	7	2	28.6
0148	7	3	42.9
0160	6	2	33.3
0178	4	1	25.0
0179	8	2	25.0
0211	8	4	50.0
0212	8	2	25.0
0218	5	1	20.0
0221	8	2	25.0
0231	8	1	12.5
0234	7	2	28.6
0252	6	0	0
0255	8	3	37.5
0268	6	2	33.3
0269	5	0	0
Totals	108	27	25.0

* PubMed Database TM1999 contains 1218 keywords.

** Bold number indicates project used in Demo B queries and analysis.

Bibliographic and technical inquiries can be requested via a secure web page form that generates an e-mail message to the TIAC staff (See Fig.5, Appendix A). The TIAC can assist MEDCOM researchers and program managers in the future in the following way. As an example, at the beginning of project planning, the principal investigator can complete a bibliographic inquiry form via the public TIAC web page to ask specific bibliographic, technical or clinical questions of the TIAC staff. Questions might relate to defining a specific technology application or infrastructure requirement, completing a search for related clinical applications in other specialties, or previous implementation of a newer technology. The TIAC staff then queries the specific TIAC databases and provides a list of pertinent references and answers to questions that assist the principal investigator in the project planning process. Principal investigators could request a second and third inquiry respectively at the middle and end of the project. This would force the investigator to incorporate the most recent literature references or results into their project results and recommendations.

2) Presentation at the ATA 2003 Annual Meeting

The American Telemedicine Association (ATA) notified the Rush Consortium that its abstract for presentation of a paper at the ATA Annual Meeting in Orlando Florida in April 2003 was accepted. This presentation provides information to the telemedicine community at large about the concept of a MEDCOM TIAC and the potential benefits of a DoD IAC. The results of the FY00 and FY01MEDCOM data analysis was presented as one example of a Technical Area Task as described in the following paragraphs. The presentation also discusses the requirements of expanding and integrating the TIAC generated bibliographic keywords with that of the NLM. An example of a website product is made available for discussion (See Fig. 4, Appendix B). Copies of the presentation's slides, and handouts are shown in Appendix B.

3) Manuscript of the TIAC Pilot Program

The manuscript describing the TIAC pilot program was submitted on April 8, 2003 for publication in the Telemedicine Journal and e-Health. A copy of the manuscript with figures and tables is shown in Appendix A and is self-explanatory.

D. SOW ¶ 3 Technical Area Tasks

1) Research Protocol

An important TIAC capability is the performance of TATs. Unlike other TIAC products and services, TATs are separately funded work efforts over and above basic TIAC products and services. Each proposal for a TAT has both a technical and cost component. TATs are very flexible and can vary from a fraction of a staff year to several staff years. Costs may vary from a few thousand dollars to several million dollars. Tasks may be ordered by any DoD component. Subject to appropriate agreement, U.S. Government agencies and departments and civilian institutions may also order TATs. There are several payment options including subscription plans,

blanket purchase agreements, and Military Interdepartmental Purchase Requests (MIPRs).

Information for funded MEDCOM FY00 and FY01 projects was retrieved from the secure TATRC website. The projects were evaluated for meeting their goals and for their usefulness. The funding cycle and date for the completion of the pilot project and the MEDCOM TAT was one year. The MEDCOM website project information was available to the TIAC and contained the pre/proposal, the proposal, the interim report and the final report from the principal investigator of funded projects. This complete data set was only available for FY00. Since the FY01 funded projects had only midterm reports, an attempt was made to contact principal investigators to obtain the final results of the project. The baseline MEDCOM TAT involved the analysis of 16 funded projects out of 156 submissions in the FY00 data sets and 20 funded projects out of 76 submissions in the FY01 data sets.

During these years the U.S. Army Medical Department funded a total of 36 research projects at a cost of $7.5 million. All projects were done within the clinical facilities of the Army Medical Department. The program oversight was done under The Telemedicine and Advanced Technology Research Center (TATRC), U.S. Army Medical Research and Materiel Command at Ft. Detrick, Maryland.

2) Results of Baseline MEDCOM TAT (FY00 / FY01 Data Sets)

Review and analysis revealed that of the thirty-six funded projects, fourteen were not completed and therefore produced no meaningful results (See Table 3, Appendix A). Several factors appear to be responsible for the lack of project outcomes. Some of the causes include a) inadequate time devoted by the researchers to the project due to other job-related responsibilities; b) inability to do a thorough bibliographic search due to lack of standardization and usage of telemedicine keywords as would be found in a robust taxonomic structure; c) delay in Institutional Review Board approval; d) inadequate coordination of project requirements with Information Management Offices personnel; and e) existing technology infrastructure that requires new acquisition or modification. No significant improvement in these parameters was noted between FY00 and FY01.

As previously mentioned under B.2.b, the TIAC retrospectively developed a controlled search process that complemented the work of the baseline TAT. This bibliographic search effort was beyond the scope and deliverable requirements of the MEDCOM Baseline TAT. A limited number of funded projects were identified as the subject of a query of the TIAC generated bibliographic database (taxonomy and keywords). They included 8 projects in FY00 and 11 projects in FY01. Key words were identified in the principal investigator's abstract and used to ascertain the completeness of the references cited in the final proposals.

Four investigators completed their research on subjects previously published in the literature. This could be attributed to the fact that eleven of the projects had an

incomplete literature search. We believe that either the researchers performed a cursory bibliographic search or that the taxonomy and keyword development for telemedicine is either inadequate in scope or non-standardized. Therefore, a complete search is not possible due to the incompleteness of information found in the NLM search engines.

3) Recommended Programmatic Direction for TIAC Development

One of the benefits of conducting the pilot project is to demonstrate the structure and use of the TIAC generated telemedicine bibliographic database, the main component of the ISS. This expanded taxonomy provides search links between documents and other information sources from public and private entities such as models, simulations, test results, etc. The taxonomy includes all terminology that defines the scope of the telemedicine.

It is assumed that the principal investigators of the FY00 and FY01 projects would have performed better having the availability of a more relevant and complete telemedicine bibliographic database. This hypothesis was tested by doing queries of the TIAC bibliographic database using funded FY00 and FY01 MEDCOM projects. A more complete literature search result was realized using the TIAC generated keywords developed by subject matter expert information sources. It is postulated that this shortcoming of the principal investigator is a consequence of a lack of standardized keywords and usage for telemedicine technology. This search can not be done completely using only the clinical medicine keywords found in the NLM (MEDLINE/ PubMed) search engines.

Perhaps the most important benefit of the pilot project is demonstrating value-added information that will be available to end-users and decision-makers. In addition to the efficient search capabilities of the bibliographic database, the TIAC staff also has a consortium of external SMEs that can provide expert responses to technical inquiries. These experts can act in an advisory role to develop strategies to insert telemedicine applications into the Triservice military medical department and other healthcare organization structures.

Historical efforts to manage and catalogue DoD telemedicine projects have had limited success and incremental benefits in the past. There has been insufficient value placed on funding priorities for training, evaluation and process improvement for selecting projects for funding. In addition to the challenges of collecting and maintaining an up-to-date central DoD database of telemedicine projects, changes in identifying or shifting priorities of strategic enterprise telemedicine objectives have compromised the expected return on investments. This variance of priorities has also led to duplicate projects resulting in inefficient use of constrained investment resources. This was shown in our analysis of the funding and the return-on-investment of telemedicine projects for the years 2000 and 2001. Of the total amount of $7.5 million, over $3 million was spent on projects that produced no measurable outcomes.

A continuing review of telemedicine technology trends and achievements should be conducted across DoD to identify areas where concisely described advances in technology development will fill a significant gap in the access, quality and cost reduction of healthcare. The TIAC is ideally suited to conduct the review of technology gaps and the scanning of proposed work that will fill these gaps.

The concept of the TIAC is central to the successful implementation of new technologies and best practices in the military health services. Military medicine is in the process of significant transformation. It is embracing e-Health and the associated efficiencies of telemedicine to address Force Health Protection and real-world priorities. These include clinical staffing shortages (e.g., radiology), Federal mandates for insuring patient privacy (i.e., Health Insurance Portability and Accountability Act implementation), and military network security concerns. Timely, remote access to medical specialty care remains an important driving force of implementing effective telemedicine applications into the main-stream business practices. Data analysis by the TIAC can assist in defining the MHS service priorities.

The Military Medical Departments and the Military Health System (MHS) require independent objective analysis of the telemedicine projects and programmatic initiatives. Based on validated measures of effectiveness, TIAC will be well positioned to provide input support for this important MHS analysis. As the new MHS e-Health portal (Tricare Online: http://www.tricareonline.com) matures, its impact supporting telemedicine applications, requires a process that incorporates existing proven operational and emerging Research and Development web applications into its inventory of web services. This process is not in place today and the TIAC databases could provide relative, objective information supporting MHS decisions in a more integrative process within the MHS of the military services.

The TIAC can also better support remote site end-users. Many of the best MHS telemedicine projects are initiated in the field at remote locations. These technical and clinical investigators, having minimal experience in the field of telemedicine, need current information from a reliable source that maximizes their valuable clinical time by avoiding time spent in fruitless literature searches. The TIAC registry of projects and associated resources could meet this need.

The TIAC can also support MHS decision-makers in designing a more programmatic approach that matches military service requirements. The MHS information technology investment decisions are based on input from Triservice working groups with limited first-hand knowledge of the complex systems under consideration for implementation. The recommendations of these working groups are then referred to senior medical leadership for validation and ultimate approval or modification. Without consistent access to objective, standardized benchmarked project profiles, these command decisions may not yield the best enterprise solutions. Similarly, next-generation R&D projects are often chosen based on investigator lobbying efforts.

Standardized project profiles will improve the objectivity of the selection process for funding.

Although conceived as a DoD resource, the TIAC can also serve as a global resource for the telehealth scientific community by a) expanding and standardizing the key words for telemedicine; b) identifying best information technology applications for incorporation into main-stream medical practice and business models; c) enhancing the productivity and effectiveness of researchers, clinicians and program managers; and d) assisting in the development of the technical and clinical standards.

3. KEY RESEARCH ACCOMPLISHMENTS

A. The following key items associated with the TIAC core program were accomplished.

- The development of a rudimentary Information Support System (ISS) was completed during the fourth quarter. A bibliographic database, public web site, and project database are included in this ISS to demonstrate proof of concept. The ISS is part of a Secure TIAC Network (STN) that will permit controlled access to files of a sensitive nature that are stored in the TIAC. The access to controlled data is achieved via a virtual private network (VPN) within the STN and Secure Sockets Layer (SSL) pages that require a login for access.
- The TIAC staff performed a limited number of retrospective bibliographic queries using MEDCOM FY00 and FY01 projects. This exercise tested the core capabilities of the TIAC ISS and provided information about the breadth and scope of references in the TIAC-generated bibliographic database. The results of the application of these queries are discussed below in the baseline MEDCOM TAT. This bibliographic search effort was not part of the MEDCOM Baseline TAT requirements.
- A public TIAC website was designed to provide users with easy access to the TIAC resources and provide researchers "one-stop shopping" in obtaining needed assistance in designing new research projects. The access is nearly universal from any desktop PC using an Internet connection and browser. Since the majority of users have experience navigating the Internet, investment in training and familiarization is kept to a minimum. All security parameters and login confidentiality are administered centrally from the TIAC server. The utility of a TIAC ISS, utilizing a website, shows its value in ease of use that avoids investments in stand-alone infrastructure costs. By logging into the TIAC website, users can initiate a secure connection to download files or view sensitive information via SSL pages.
- A presentation titled "Telemedicine Information Analysis Center (TIAC)" was accepted and presented at the American Telemedicine Association (ATA) 2003 8th Annual Meeting & Exposition held in Orlando, Florida on April 27-30, 2003.

- A manuscript describing the TIAC Plot Program was submitted for publication in the Telemedicine Journal and e-Health.

B. The following key items associated with the TIAC Baseline TAT were accomplished during this third quarter.

- MEDCOM FY00 and FY01 projects were evaluated for meeting their goals and for their usefulness. The MEDCOM website project information was available to the TIAC and contained the pre/proposal, proposal, interim report and the final report from the principal investigator of funded projects. This complete data set was only available for FY00. The baseline MEDCOM TAT involved the analysis of 16 funded projects out of 156 submissions in the FY00 data sets and 20 funded projects out of 76 submissions in the FY01 data sets.
- Review and analysis revealed that of the thirty-six funded projects, fourteen were not completed and therefore produced no meaningful results. Several factors appear to be responsible for the lack of project outcomes. Some of the causes include a) inadequate time devoted by the researchers to the project due to other job-related responsibilities; b) inability to do a thorough bibliographic search due to lack of standardization and usage of telemedicine keywords as would be found in a robust taxonomic structure; c) delay in Institutional Review Board approval; d) inadequate coordination of project requirements with Information Management Offices personnel; and e) existing technology infrastructure that requires new acquisition or modification. No significant improvement in these parameters was noted between FY00 and FY01.
- As mentioned above, the TIAC retrospectively developed a controlled search process that complemented the work of the baseline TAT. This work was not part of the Baseline MEDCOM TAT. A limited number of funded projects were identified as the subject of a query of the TIAC generated bibliographic database. They included 8 projects in FY00 and 11 projects in FY01. Keywords were identified in the principal investigator's abstract and used to ascertain the completeness of the references cited in the final proposals. Four investigators completed their research on subjects previously published in the literature. This could be attributed to the fact that eleven of the projects had an incomplete literature search. We believe that either the researchers performed a cursory bibliographic search or that the keyword structure and parameter development for telemedicine is either inadequate in scope or non-standardized.
- The concept of the TIAC is central to the successful implementation of new technologies and best practices in the military health services. Military medicine is in the process of significant transformation. It is embracing e-Health and the associated efficiencies of telemedicine to

address Force Health Protection and real-world priorities. These include clinical staffing shortages (e.g., radiology), Federal mandates for insuring patient privacy (i.e., Health Insurance Portability and Accountability Act implementation), and military network security concerns. Timely, remote access to medical specialty care remains an important driving force of implementing effective telemedicine applications into the main-stream business practices. Data analysis by the TIAC can assist in defining the MHS service priorities.

- Although conceived as a DoD resource, the TIAC can also serve as a global resource for the telehealth scientific community by; a) expanding and standardizing the keyword structure for telemedicine; b) identifying best information technology applications for incorporation into main-stream medical practice and business models; c) enhancing the productivity and effectiveness of researchers, clinicians and program managers; and d) assisting in the development of the technical and clinical standards.

4. REPORTABLE OUTCOMES

A. Manuscripts, Abstracts, and Presentations
   1) Slides, and handouts for presentation at the American Telemedicine Association 2003 8th Annual Meeting & Exposition held in Orlando, FL on April 27-30, 2003.
   2) Manuscript of TIAC Pilot Program submitted for publication in Telemedicine Journal and e-Health.

B. Patents and Licenses
   1) None

C. Informatics
   1) Development of rudimentary TIAC Website.
   2) Development of a web-based bibliographic inquiry request form.

D. Funding Applied for Based on Work Supported by TIAC
   1) None

5. CONCLUSIONS

A. Results

This current program is a pilot study that establishes the basic functions and assesses the benefits provided by a Telemedicine Information Analysis Center (TIAC). The assessment is achieved by reviewing past MEDCOM research and development programs and evaluating ways in which the TIAC can add value to the utility that these programs provide to the Service Medical Departments.

The development of a rudimentary Information Support System (ISS) was completed during the fourth quarter. A bibliographic database, public web site, and project database are included in this ISS to demonstrate proof of concept. The ISS is part of a Secure TIAC Network (STN) that will permit controlled access to files of a sensitive nature that are stored in the TIAC. The access to controlled data is achieved

via a virtual private network (VPN) within the STN and Secure Sockets Layer (SSL) pages that require a login for access.

In addition to the Baseline TAT, the TIAC conducted a limited number of retrospective bibliographic queries using MEDCOM FY00 and FY01 projects. This exercise tested the core capabilities of the TIAC ISS and provided information about the breadth and scope of references in the TIAC-generated bibliographic database. This bibliographic search procedure development is beyond the scope and required deliverables of the baseline MEDCOM TAT. A problem encountered in searching for references was due to the lack of alignment between the keywords used by the MEDCOM researchers and the those keywords used in the PubMed databases. However, even with this lack of uniformity with keywords, many appropriate and helpful references were retrieved that provide important information for MEDCOM program managers as well as the researchers.

Information for funded MEDCOM FY00 and FY01 was retrieved from the secure TATRC website. The projects were evaluated for meeting their goals and for their usefulness. The baseline MEDCOM TAT involved the analysis of 16 funded projects out of 156 submissions in the FY00 data sets and 20 funded projects out of 76 submissions in the FY01 data sets. Review and analysis revealed that of the thirty-six funded projects, fourteen were not completed and therefore produced no meaningful results (See Table 3, Appendix A). Several factors appear to be responsible for the lack of project outcomes. Some of the causes include a) inadequate time devoted by the researchers to the project due to other job-related responsibilities; b) inability to do a thorough bibliographic search due to lack of standardization and usage of telemedicine keywords as would be found in a robust taxonomic structure; c) delay in Institutional Review Board approval; d) inadequate coordination of project requirements with Information Management Offices personnel; and e) existing technology infrastructure that requires new acquisition or modification. No significant improvement in these parameters was noted between FY00 and FY01.

B. Recommendations for Future Work

The concept of the TIAC is central to the successful implementation of new technologies and Best Practices in the Services. The design, execution and the Services ongoing participation is essential to realizing its potential benefits and value. Army Medicine is in the process of a significant transformation. It is embracing e-Health and the associated efficiencies of telemedicine to address Force Protection and real world near-term issues. These include clinical staffing shortages (i.e. Radiology), Federal patient medical privacy priorities (i.e. HIPAA issues) and military network security concerns. Timely, remote access to medical specialty care remains an important driving force for effective telemedicine. The proposed data analysis from the TIAC supports these service priorities.

The following paragraphs present recommendations for future work beyond the TIAC core program pilot study and baseline TAT. These recommendations are drawn from

the analyses conducted on the current program and from information obtained from meetings and discussions with experts in the government and civilian sector of the telemedicine community. The primary source for the information presented below was the ATA 2003 Annual Meeting held in Orlando Florida on April 26-30, 2003.

Homeland Security Support: The TIAC staff was invited by Mr. Conrad Clyburn of TATRC to attend a special session of the ATA 2003 Annual Meeting concerned with Homeland Security (HLS) and its relationship with the ATA and DoD. This special meeting was conducted as a workshop for supporting the HSL Advanced Concept Technology Demonstration (ACTD) for Command and Control (C2). Mr. James J. Southerland briefed the workshop on the HSL C2 ACTD. The workshop explored ways in which DoD can insert medical capabilities into the HSL ACTD.

The workshop was structured as three panels which addressed the medical topics associated with technology identification and prioritization in the areas of:

- assured connectivity,
- threat attribution,
- command, control, and coordination.

One future area of development that will support the above areas is an information analysis center (IAC) focused in the medical aspects of homeland security. This IAC can be implemented as an extension of the current TIAC for the purpose of collecting, analyzing, synthesizing, and disseminating worldwide scientific and technical information on emergency telemedicine, medical informatics, and medical response procedures for Chem-Bio attacks. This Chem-Bio IAC would be a mechanism to prevent duplication in studies, enhance the effectiveness of current studies, and centralize information for use in education and training. Such an IAC was proposed by the Rush Consortium as part of a Chem-Bio Attack Response Center (CBARC)[5].

Although conceived as a DoD resource, the analysis center can be based at any federal or civilian academic center. It can function independently as a repository of pertinent data and subject matter experts or play a supporting role for other information analysis centers.

WRAMC and CTA Collaboration: Two important contacts were made for future testing of the prototype for the Secure TIAC Network and the TIAC website. They are:

a) The Telemedicine Directorate of the North Atlantic Regional Medical Command, Walter Reed Army Medical Center, 6900 Georgia Ave., NW, Washington, DC 20307-5001, (www.wramc.amedd.army.mil)
b) The Distance Learning and Multimedia Department , The Center for Total Access, Building 38711, Fort Gordon, GA 30905-5650 (www.cta.ha.osd.mil)

Both contacts were interested in collaborating with further development of a Telemedicine Information Analysis Center. WRAMC would be an excellent testing ground of the VPN prototype to their existing Information Services Network and providing opinions from clinical and information technology subject matter experts (in the Military Health System) for the Subject Matter Expert Data Base. It would

also demonstrate "proof-of-principle" for the secure TIAC network within a clinical and research context. The Center for Total Access is doing a variety of multimedia developmental products such as the Special Forces Handbook. The digital handbook uses an Oracle-based search engine that links disparate information sources to providing real-time answers immediately. The computer programming that is the basis of the success of their product can be applied to the TIAC for the next level of development.

At present, the TIAC website address can be accessed at www.tiac.rush.edu until the reserved domain name of www.tiac.info is activated with a new user ID by Rush Information Services.

6. REFERENCES

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7. APPENDICES

A. Manuscript of TIAC Pilot Program
B. TIAC Paper Presented at ATA Symposium, Slides and Handouts
C. MEDCOM Project Queries, Bibliographic Search Specs

Appendix A
Manuscript of TIAC Pilot Program

TITLE: Telemedicine Information Analysis Center (TIAC)

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This research was conducted between February 11, 2002 - April 30, 2003 under the sponsorship of the Telemedicine and Advanced Technology Research Center (TATRC), U.S. Army Research and Materiel Command, ATTN: MCMR-AT, 504 Scott Street, Fort Detrick, MD 21702-5012, (E-mail: tatrc@army.mil and website: http://www.tatrc.org), and supported by Award No. DAMD17-02-0020, U.S. Army Medical Research Acquisition Activity, ATTN: MCMR-AAA, 820 Chandler St., Fort Detrick, MD 21702-5014.

Joan T. Zajtchuk, M.D., Spec. in H.S.A., Professor Emeritus, Department of Otolaryngology & Bronchoesophagology, Rush Medical College, Advanced Technology and International Health, Rush-Presbyterian-St. Luke's Medical Center, 707 S. Wood St., Chicago, IL, 60612. Telephone: (312) 942-6348;
FAX: (312) 942-4293; e-mail: Joan_Zajtchuk@rush.edu. Corresponding author.

Russ Zajtchuk, M.D., Professor Emeritus, Cardiovascular Surgery, Rush Medical College, Advanced Technology and International Health, Rush-Presbyterian-St. Luke's Medical Center, 707 S. Wood St., Chicago, IL, 60612. Telephone: (312) 942-6348; FAX: (312) 942-4293; e-mail: Russ_Zajtchuk@rush.edu

Joseph J. Petrovic, MSEE, President, InteleDatics, Inc., 8501 Clynderven Road, Burr Ridge IL 60527-8363. Telephone: (630) 248-1501; FAX: (630) 323-9281; e-mail: jpetrovic@inteledatics.com.

Ryan P. Gutz, B.A., Network Analyst, Information Services Division,1700 West Van Buren, Suite 374, Chicago, IL, 60612. Telephone: (312) 942 -4603; FAX: (312) 942-4062; e-mail: Ryan_P_Gutz@rush.edu.

Benjamin D. Walrath, B.A., Ensign, USNR, Rush Medical College, 600 S. Paulina Street, Chicago, IL 60612. E-mail: Benjamin_Walrath@rush.edu

TELEMEDICINE INFORMATION ANALYSIS CENTER

Congress mandated a pilot project to demonstrate the feasibility of establishing a Department of Defense (DoD) telemedicine information analysis center (TIAC). The project consisted of a) designing a medical information support system that will show the core capabilities of a TIAC and b) performing a specific baseline technical area task (TAT) for the U.S. Army Medical Command (MEDCOM). The productivity and effectiveness of telemedicine researchers and clinical practitioners can be enhanced by the existence of an information analysis center devoted to the collection, analysis, synthesis and dissemination of worldwide scientific and technical information related to the field of telemedicine. Information Analysis Centers (IACs) accomplish their mission by providing in-depth analysis services and creating specialized information products. They respond to bibliographic and technical inquiries, prepare state-of-the-art reports, handbooks and databooks, perform technology assessments, and support exchanges of information among researchers and practitioners of various disciplines within the scope of the IAC. The work conducted under the TIAC pilot project establishes the basic IAC functions and assesses the utility of the TIAC to the military medical departments. The pilot project capabilities are web-based and include (a) applying the science of classification (taxonomy) to telemedicine to identify key words; (b) creating a relational database of this taxonomy to a bibliographic database using these key words; (c) developing and disseminating information via a public TIAC web site; (d) performing a baseline MEDCOM TAT; and e) providing analyses by subject matter experts (SMEs) for critique of the TIAC pilot project.

INTRODUCTION

BACKGROUND

In 1997 the General Accounting Office(GAO), in a report to Congress, recommended that a Federal strategy be developed to guide investments in the field of telemedicine.[1] The GAO report calls on the Department of Defense(DoD) to help forge a government-wide strategy for using and gauging success of telemedicine technology in the federal area. In 2001, Congress directed the DoD to conduct a pilot project to determine the feasibility of establishing a DoD Telemedicine Information Analysis Center(TIAC) with the goal of maximizing return-on-investment and developing better coordination and exchange of information and analysis of telemedicine projects.[a] The Center for Advanced Technology at Rush-Presbyterian-St. Luke's Medical Center and its consortium partner InteleDatics, Inc. were awarded the task to conduct a pilot project and create a Telemedicine Information Analysis Center (TIAC) to support investigators and decision-makers in the field of telemedicine. It was proposed that the TIAC be web-based and its core capabilities should include a) the application of the science of classification (taxonomy) to telemedicine to identify keywords; b) the creation of a relational database of this taxonomy to a bibliographic database using the keywords; c) the capability to perform analysis of clinical and technological queries by TIAC staff; d) the capability to prepare and disseminate reports via a public TIAC website; and e) the capability to perform technical area tasks (TATs) upon request.

MATERIALS AND METHODS

In order to understand the concept of an information analysis center (IAC) and the role the DoD plays in sponsoring IACS, a brief discussion is provided about IACs.

The Defense Technical Information Center (DTIC)[2] is the central facility for the collection and dissemination of scientific and technical information for the DoD. Much of this information is made available by DTIC in the form of technical reports about completed research, and research summaries of ongoing research. As an element of the Defense Information Systems Agency, DTIC supports the warfighter and serves as a vital link in the transfer of information among DoD personnel, DoD contractors and potential contractors and other U.S. Government Agency personnel and their contractors. DTIC's use of leading edge technology allows customized information to be gathered at rapid speeds and deployed to its customers using state-of-the-art communications. User registration is required to utilize DTIC's products and services.

To improve the productivity of those who use scientific and technical information to

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[a] Sec 315. Of the total amount appropriated by title IV of the Department of Defense Appropriations Act, 2001 (Public Law 106-259) under the heading "Research, Development, Test and Evaluation, Army,"....and not less than $1,000,000 shall be made available only to conduct a pilot study to determine the feasibility of establishing a Department of Defense Information Analysis Center for telemedicine."

accomplish a DoD mission objective, DTIC manages 13 IACs staffed by experienced information specialists, scientists and engineers who help customers locate, analyze and use scientific and technical information in a specialized subject area.

There are economies of scale realized in an IAC. In general, IACs accomplish their mission by providing in-depth analytical services and create specialized technical documents. IAC's provide responses to technical inquiries, prepare state-of-the-art reports, handbooks and databooks, perform technology assessments, and support information exchanges among researchers. IAC analytical services can contribute to the production of affordable systems. The IACs provide program managers with affordable short- and long-term analytical services using premier commercial and government scientific and technical databases, government lessons-learned databases, and internally developed special-need databases. DoD Program Managers and research sponsors can therefore capitalize on the specific skills of the IAC staff and maximize their tight budgets by avoiding duplication of effort. The IAC staff assists in this process by locating and analyzing data and reports using tools found in databases of previously developed products or systems. IACs can assist researchers in designing sound protocols based on an accurate and comprehensive literature search.

The pilot project is funded for one year and includes a) designing a web-based medical IAC that will show the basic capabilities of the information support system (ISS), a secure information technology network and a public website; b) developing of an "up-to-date" compendium of telemedicine keywords imbedded within the taxonomy of telemedicine; and c) performing a baseline TAT analyzing funded MEDCOM telemedicine projects. Additionally, the TIAC identified a small group of other selected SMEs who are well recognized in the telemedicine area or in program management or implementation.

The work conducted under the pilot program includes a) establishing the basic IAC core functions and b) assessing the usefulness of the TIAC by conducting a baseline TAT that analyzed funded MEDCOM telemedicine projects. This baseline TAT consisted of reviewing interim and final reports of FY00 and FY01 research and development projects. The completion of the MEDCOM TAT demonstrated the proof-of- principle of a telemedicine IAC.

Pilot Project: Telemedicine Information Analysis Center (TIAC)

TASK A: Design and develop TIAC structure and functions

1. Implement an exportable TIAC Information Support System (ISS)

A rudimentary Information Support System (ISS) was developed under the pilot program based on the standard components found in an IAC ISS (See Fig.1). A bibliographic database, public web site, and project database are included in this ISS to demonstrate proof of concept. The ISS is part of a Secure TIAC Network (STN) that will permit controlled access to files of a sensitive nature that are stored in the TIAC.

The access to controlled data is achieved via a virtual private network (VPN) within the STN and Secure Sockets Layer (SSL) pages that require a login for access.

A configuration of hardware and software selected for the STN, allows a proof of concept demonstration using commercial-off-the-shelf (COTS) items. The VPN provides access at any site for the TIAC staff to the bibliographic database and files and also provides the ability to maintain the web server remotely. A dedicated firewall device connects the TIAC STN to the Internet. This firewall is directly attached to Rush's incoming Internet connection and is completely separate from the Rush Medical Center's hospital network.

The COTS product selected for the pilot study, Reference Manager™, is not a relational database. This database structure has been conceived and designed to achieve the equivalent performance of a relational system. The requirements of the database usage are just now being experimentally defined and tested (See Fig. 2). The database application to be used in the mature TIAC will be Oracle™, the DoD database of choice. This program is a relational database that incorporates features that are desirable for bibliographic applications. However, the cost and complexity of an Oracle™ database program was not justified for the ISS of the pilot project where funds were limited. All material in the Reference Manager™ database can be migrated to Oracle™ when the level of funding and staffing resources can support a mature program.

The second important element of establishing the ISS is compiling a state-of-the art bibliographic database that is specific to telemedicine (See Table 1). Effort was directed toward populating the TIAC bibliographic database using Reference Manager™ as the database application program. The objective of this initial step is to compile a sample listing of references that can be used in testing the query capabilities of a database search. It also serves to capture the reference data that is applicable to TIAC information collection requirements. Two primary sources were used for the collection of references. One source of references was those used in a recent state-of-the-art telemedicine symposium focusing from an international perspective[3]. This symposium involved invited speakers, panel members, and other participants who represented the leaders in experience and achievement in telemedicine/telehealth applications, science, technology, and in telemedicine program and policy development. The second source of bibliographic references used for the TIAC database was PubMed. PubMed, a service of the National Library of Medicine (NLM), provides access to over 12 million MEDLINE citations back to the mid-1960's and additional life science journals. PubMed includes links to many sites providing full text articles and other related resources. Several subsets of the PubMed were searched for references associated with telemedicine where the subsets corresponded to various years in which the references were collected.

The development of a mature TIAC (> Year 2) is beyond the scope of the pilot project. Mature IACs provide a central source of research, development, and testing information and also hold symposia, workshops and conferences to bring all the relevant parties together. Technology developers, warfighters, and program managers can simply call the

IACs to discover which industrial and defense organizations, tools, and research, testing, evaluation, and training methods can contribute best to fulfilling their mission.

2. Design and Develop a Secure TIAC Network (STN)

The infrastructure of the TIAC is based within the ISS and a STN (See Fig. 3). The hardware and software configuration used in designing the STN and the ISS consists of the following:

Hardware:
1 Dell™ Server
3 Dell™ desktop PC's
2 Laptops (Dell™ /Gateway™)
1 Sofaware™, firewall device with CheckPoint™ software
1 Dell™ managed switch

Software:
Microsoft ™ Windows 2000 Server
- Microsoft™ Internet Information Server (Web Server)
- Microsoft™ Certificate Services for Security
- Microsoft™ Routing Remote Manager (VPN)

Internet Explorer™ ver. 5.5
Reference Manager™ ver. 10

Specific technical documentation for the configuration of the equipment is not practical to include here. Critical elements about the system are described in the following paragraphs.

Project overview (STN):
The pilot project establishes a web presence with security for users' data and a VPN to provide secure remote database management for TIAC staff and other users.

The STN currently uses Windows™ 2000 Server on one Dell server that runs Reference Manager™ and the Microsoft™ Internet Information Server and functions as a VPN. SSL pages in the secure portion of the web site facilitate encrypted logins and file downloads.

Security:
Security is a primary concern with any system connected to the Internet. A dedicated firewall device connects the server to the Internet. This firewall is attached directly to Rush's incoming Internet connection, completely separate from the Rush network. A dedicated PC, running network intrusion detection software, monitors for any intrusion. Anti-virus software is installed on the VPN and web servers. For simplicity in this project, Point-to-Point Tunneling Protocol (PPTP), is used for data transfer through the VPN. Internet Protocol Security (IPSec) is a newer protocol used with VPN's that offers

greater security for data. Although IPSec is the protocol of choice, it is beyond the scope of this project.

Scalability:
Scalability for this pilot project is expected to conservatively accommodate up to 500 users. This package represents a central communications point / website that can be duplicated exactly, enhanced with more powerful hardware and software or migrated to other systems. The scope of this project is not limited by proprietary systems. For example, the database and search capabilities of Reference Manager™ can be transferred to, and further developed upon migration to Oracle™. The Microsoft™ software running on Dell™ servers can accomplish the same security and functionality that is possible with a Linux™ operating system and Apache™ web server. The advantage of this model leverages the interchangeable nature of the components. Other vendors may be chosen for any piece of the project to accommodate growth and to capitalize on rapidly evolving technology.

Assumptions:
Users should be able to connect to a TIAC from their desktop PC with an Internet connection (See Fig 1 and Table 4). The user groups listed in Table 4 are typical for an IAC. The level of user access to the secure network files would be categorized according to each user's "need to know." Categories include TIAC staff and Federal Sponsors of the TIAC, other governmental personnel, civilian subscribers, registered civilians, and the general public. Group C, Civilian Subscribers, includes organizations and individuals that are currently working on programs under a formal DoD contract. These groups are bound to conform to all government regulations and procedures for information security. Therefore, the access to information allowed to Groups A, B, and C is based on the knowledge that these organizations and individuals will follow all procedures to protect sensitive information relating to national security, company proprietary regulations, etc. Groups D and E, however, include individuals not under any formal governmental regulations for information security and can not be held to the same government restrictions for information security. Their access to IAC information would, therefore, be limited to material of a non-sensitive nature. In the case of a medical IAC such as the mature TIAC, access to patient information will be regulated under the Health Insurance Portability and Accountability Act (HIPAA).

Outlook:
The foreseeable evolution of the TIAC ISS is a web portal. A portal helps to consolidate the functions of the ISS into a unified user experience and simplifies management. It is currently the best balance of security and ease of access for the user. For example, nearly all communications relating the TIAC operations could be accomplished with one link through a browser (Internet Explorer™) and one login for the whole site. The purpose of the VPN could allow TIAC staff remote access to the TIAC databases through a secure data conduit. It would also permit the secure connection to other databases at remote facilities that have authorized access.

3. Design and develop a public TIAC website

The public TIAC website provides users with easy access to the TIAC resources and provides researchers "one-stop shopping" in obtaining needed assistance in designing new research projects (See Fig.4). The access is nearly universal from any desktop PC using an Internet connection and browser. Since the majority of users have experience navigating the Internet, investment in training and familiarization is kept to a minimum. All security parameters and login confidentiality are administered centrally from the TIAC server. The utility of a TIAC ISS, utilizing a website, shows its value in ease of use that avoids investments in stand-alone infrastructure costs. By logging into the TIAC website with COTS browsers like Internet Explorer™, users can initiate a secure connection to download files or view sensitive information via SSL pages.

Bibliographic and technical inquiries can be requested via a secure web page form that generates an e-mail message to the TIAC staff (See Fig.5). The TIAC can assist MEDCOM researchers and program managers in the future in the following way. As an example, at the beginning of project planning, the principal investigator can complete a bibliographic inquiry form via the public TIAC webpage to ask specific bibliographic, technical or clinical questions of the TIAC staff. Questions might relate to defining a specific technology application or infrastructure requirement, completing a search for related clinical applications in other specialties, or previous implementation of a newer technology. The TIAC staff then queries the specific TIAC databases and provides a list of pertinent references and answers to questions that assist the principal investigator in the project planning process. Principal investigators could request a second and third inquiry respectively at the middle and end of the project. This would force the investigator to incorporate the most recent literature references or results into their project results and recommendations.

Another area expected to improve the return-on-investment of telemedicine research projects is in identifying critical gaps in technology development. Program managers can benefit from TIAC expertise by requesting a gap analysis of projects and trends in order to make better selection decisions for funding of future MEDCOM projects. This step will also insure success in meeting programmatic goals. As an example, a continuing review of telemedicine technology trends and achievements could be conducted across the DoD. Such an analysis would identify advances in technologies or clinical applications that can fill a gap in the access, quality, or cost of healthcare. It would also suggest research thrust areas that would achieve specific goals for MEDCOM initiatives. All past unfunded projects should also be reviewed and funded if they prove to fill these gaps.

TASK B: Design and Test the Capabilities of a TIAC

1. Develop keywords and taxonomy of telemedicine

A preliminary step, under the pilot program, in testing the core function of the TIAC is to develop the taxonomy of telemedicine (See Table 2). It was also necessary to define and

characterize the scope of telemedicine. Therefore, the primary effort was to create and adopt a collection of universally accepted technical keywords and to categorize these keywords into a logical taxonomic structure that links related information. This is the primary benefit of defining and adopting a robust taxonomy of telemedicine into common use. Therefore, the science of taxonomy is being applied to telemedicine in order to facilitate searches of related information using keywords.

The TIAC developed a telemedicine taxonomy structure by creating a keyword list using several telemedicine resources. [2,3,4,5,6,7,8,9] The references selected represent past and current documents that have been used frequently as telemedicine source material. Funded MEDCOM projects were classified according to the Army Medical Department's e-Business strategy and also according to the level of maturity that medical specialties have incorporated telemedicine technology into their practices. The concept of the level of maturity was defined and referenced in the Telemedicine / Telehealth Symposium.[10]

The TIAC is not developing a new information database source solely for telemedicine, but is linking to the NLM, a well-established resource familiar to and accepted by the medical community (See Table 2). The clinical applications for telemedicine in medicine, although very broad in range, are well established in terms of terminology and categorization in the National Library of Medicine (MEDLINE/PubMed) databases.[11] However, the keyword categories for information technology that are the underpinning of telemedicine searches, is evolving at a very rapid rate with the increased applications of information technology in healthcare and computer system innovations. There is a paucity of this category of telemedicine terminology in the NLM MeSH tree structure. The taxonomic structure for the technology keywords of telemedicine terminology is being developed in the TIAC program in an attempt to link it with the NLM search engines. The TIAC pilot project, in a brief comparison of keywords, showed a need to expand the NLM database. The TIAC generated taxonomy and structure, compiling a telemedicine vocabulary from a limited search of peer-reviewed references, is shown in Table 2.

A work plan was developed that included comparing the telemedicine terminology found in the TIAC-generated keyword structure as it relates to the MeSH categories in the NLM. The NLM was contacted and a recommendation for expanding the MeSH categories and keywords of the technology categories as found in the TIAC taxonomy was proposed.

Ultimately the telemedicine community should convene an expert panel to review and further develop the taxonomy of telemedicine using standardized keywords. The process would address both the technical and clinical elements of telemedicine terminology for adoption for standard usage. The standardization and acceptance of these keywords by both the telemedicine community and within the NLM search engines would greatly facilitate retrieval of bibliographic references by researchers in the field.

2. Develop Procedure for Bibliographic and Technical Searches

The baseline MEDCOM TAT provided the impetus for the TIAC to perform a limited number of retrospective bibliographic queries using MEDCOM FY00 and FY01 projects. This procedure could also be used to perform technical inquiries. This exercise tested the core capabilities of the TIAC ISS and provided information about the breadth and scope of references in the TIAC-generated bibliographic database. This bibliographic search procedure, not a part of the baseline TAT, will be described in the baseline MEDCOM TAT.

TASK C. Perform Technical Area Task (TAT): Baseline MEDCOM TAT

1. Research Protocol

An important TIAC capability is the performance of TATs. Unlike other TIAC products and services, TATs are separately funded work efforts over and above basic TIAC products and services. Each proposal for a TAT has both a technical and cost component. TATs are very flexible and can vary from a fraction of a staff year to several staff years. Costs may vary from a few thousand dollars to several million dollars. Tasks may be ordered by any DoD component. Subject to appropriate agreement, U.S. Government agencies and departments and civilian institutions may also order TATs. There are several payment options including subscription plans, blanket purchase agreements, and Military Interdepartmental Purchase Requests (MIPRs).

Information for funded MEDCOM FY00 and FY01 was retrieved from the secure TATRC website. The projects were evaluated for meeting their goals and for their usefulness. The funding cycle and date for the completion of the pilot project and the MEDCOM TAT was one year. The MEDCOM website project information was available to the TIAC and contained the pre/proposal, the proposal, the interim report and the final report from the principal investigator of funded projects. This complete data set was only available for FY00. Since the FY01 funded projects had only midterm reports, an attempt was made to contact principal investigators to obtain the final results of the project. The baseline MEDCOM TAT involved the analysis of 16 funded projects out of 156 submissions in the FY00 data sets and 20 funded projects out of 76 submissions in the FY01 data sets.

During these years the U.S. Army Medical Department funded a total of 36 research projects at a cost of $7.5 million. All projects were done within the clinical facilities of the Army Medical Department. The program oversight was done under The Telemedicine and Advanced Technology Research Center (TATRC), U.S. Army Medical Research and Materiel Command at Ft. Detrick, Maryland.

2. Results of the Baseline MEDCOM TAT (FY00 /FY01 data sets)

Review and analysis revealed that of the thirty-six funded projects, fourteen were not completed and therefore produced no meaningful results (See Table 3). Several factors

appear to be responsible for the lack of project outcomes. Some of the causes include a) inadequate time devoted by the researchers to the project due to other job-related responsibilities; b) inability to do a thorough bibliographic search due to lack of standardization and usage of telemedicine keywords as would be found in a robust taxonomic structure; c) delay in Institutional Review Board approval; d) inadequate coordination of project requirements with Information Management Offices personnel; and e) existing technology infrastructure that requires new acquisition or modification. No significant improvement in these parameters was noted between FY00 and FY01.

As previously mentioned under B.2, the TIAC retrospectively developed a controlled search process that complemented the work of the baseline TAT. A limited number of funded projects were identified as the subject of a query of the TIAC generated bibliographic database (taxonomy and keywords). They included 8 projects in FY00 and 11 projects in FY01. Key words were identified in the principal investigator's abstract and used to ascertain the completeness of the references cited in the final proposals.

Four investigators completed their research on subjects previously published in the literature. This could be attributed to the fact that eleven of the projects had an incomplete literature search. We believe that either the researchers performed a cursory bibliographic search or that the taxonomy and keyword development for telemedicine is either inadequate in scope or non-standardized. Therefore, a complete search is not possible due to the incompleteness of information found in the NLM search engines.

Discussion:

One of the benefits of conducting the pilot project is to demonstrate the structure and use of the TIAC generated telemedicine bibliographic database, the main component of the ISS. This expanded taxonomy provides search links between documents and other information sources from public and private entities such as models, simulations, test results, etc. The taxonomy includes all terminology that defines the scope of the telemedicine.

It is assumed that the principal investigators of the FY00 and FY01 projects would have performed better having the availability of a more relevant and complete telemedicine bibliographic database. This hypothesis was tested by doing queries of the TIAC bibliographic database using funded FY00 and FY01 MEDCOM projects. A more complete literature search result was realized using the TIAC generated keywords developed by subject matter expert information sources. It is postulated that this shortcoming of the principal investigator is a consequence of a lack of standardized key words and usage for telemedicine technology. This search can not be done completely using only the clinical medicine keywords found in the NLM (MEDLINE/ PubMed) search engines.

Perhaps the most important benefit of the pilot project is demonstrating value-added information that will be available to end-users and decision-makers. In addition to the efficient search capabilities of the bibliographic database, the TIAC staff also has a

consortium of external SMEs that can provide expert responses to technical inquiries. These experts can act in an advisory role to develop strategies to insert telemedicine applications into the Triservice military medical department and other healthcare organization structures.

Historical efforts to manage and catalogue DoD telemedicine projects have had limited success and incremental benefits in the past. There has been insufficient value placed on funding priorities for training, evaluation and process improvement for selecting projects for funding. In addition to the challenges of collecting and maintaining an up-to-date central DoD database of telemedicine projects, changes in identifying or shifting priorities of strategic enterprise telemedicine objectives have compromised the expected return on investments. This variance of priorities has also led to duplicate projects resulting in inefficient use of constrained investment resources. This was shown in our analysis of the funding and the return-on-investment of telemedicine projects for the years 2000 and 2001. Of the total amount of $7.5 million, over $3 million was spent on projects that produced no measurable outcomes.

A continuing review of telemedicine technology trends and achievements should be conducted across DoD to identify areas where concisely described advances in technology development will fill a significant gap in the access, quality and cost reduction of healthcare. The TIAC is ideally suited to conduct the review of technology gaps and the scanning of proposed work that will fill these gaps.

The concept of the TIAC is central to the successful implementation of new technologies and best practices in the military health services. Military medicine is in the process of significant transformation. It is embracing e-Health and the associated efficiencies of telemedicine to address Force Health Protection and real-world priorities. These include clinical staffing shortages (e.g., radiology), Federal mandates for insuring patient privacy (i.e., Health Insurance Portability and Accountability Act implementation), and military network security concerns. Timely, remote access to medical specialty care remains an important driving force of implementing effective telemedicine applications into the main-stream business practices. Data analysis by the TIAC can assist in defining the MHS service priorities.

The Military Medical Departments and the Military Health System (MHS) require independent objective analysis of the telemedicine projects and programmatic initiatives. Based on validated measures of effectiveness, TIAC will be well positioned to provide input support for this important MHS analysis. As the new MHS e-Health portal (Tricare Online: http://www.tricareonline.com) matures, its impact supporting telemedicine applications, requires a process that incorporates existing proven operational and emerging Research and Development web applications into its inventory of web services. This process is not in place today and the TIAC databases could provide relative, objective information supporting MHS decisions in a more integrative process within the MHS of the military services.

The TIAC can also better support remote site end-users. Many of the best MHS telemedicine projects are initiated in the field at remote locations. These technical and clinical investigators, having minimal experience in the field of telemedicine, need current information from a reliable source that maximizes their valuable clinical time by avoiding time spent in fruitless literature searches. The TIAC registry of projects and associated resources could meet this need.

The TIAC can also support MHS decision-makers in designing a more programmatic approach that matches military service requirements. The MHS information technology investment decisions are based on input from Triservice working groups with limited first-hand knowledge of the complex systems under consideration for implementation. The recommendations of these working groups are then referred to senior medical leadership for validation and ultimate approval or modification. Without consistent access to objective, standardized benchmarked project profiles, these command decisions may not yield the best enterprise solutions. Similarly, next-generation R&D projects are often chosen based on investigator lobbying efforts. Standardized project profiles will improve the objectivity of the selection process for funding.

Although conceived as a DoD resource, the TIAC can also serve as a global resource for the telehealth scientific community by a) expanding and standardizing the key words for telemedicine; b) identifying best information technology applications for incorporation into main-stream medical practice and business models; c) enhancing the productivity and effectiveness of researchers, clinicians and program managers; and d) assisting in the development of the technical and clinical standards.

Acknowledgements: The authors wish to acknowledge the work of the SMEs for their input and critique of the TIAC pilot project. The reviewers include a) Richard S. Bakalar, CAPT, M.C. USN; b) Alcide M. LaNoue, M.D., LTG (ret), USA; c) Enrique Mendez, M.D., MG (ret), USA; d) Charles H. Roadman II, M.D., LTG (ret), USAF; e) Jay H. Sanders, M.D; and f) Rashid L. Bashshur, Ph.D. The authors also wish to acknowledge the support of the Advanced Technology Administrative Assistant, Ms. Carole Arch for her detailed attention in the execution of this grant as well as the work of Benjamin D.Walrath, a medical student at Rush Medical College.

Reprint Requests should be sent to:

Joan T. Zajtchuk, M.D., Spec. in H.S.A., Professor Emeritus, Department of Otolaryngology & Bronchoesophagology, Rush Medical College, Advanced Technology and International Health, Rush-Presbyterian-St. Luke's Medical Center, 707 S. Wood St., Chicago, IL, 60612. Telephone: (312) 942-6348;
FAX: (312) 942-4293; e-mail: Joan_Zajtchuk@rush.edu. Corresponding author.

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Table Titles and Captions

Table 1. References for TIAC Bibliographic Database[3-9]

The TIAC bibliographic database includes a total of 5165 references specifically compiled from PubMed and subject matter expert information from peer-reviewed sources. The PubMed keywords are found in the NLM search engines. Other TIAC keyword taxonomy was developed from subject matter expert information resources.[3-9]

Table 2. TIAC Generated Telemedicine Taxonomy and Structure[3-9]

This table shows telemedicine keywords grouped according to taxonomy that the TIAC identified from peer-reviewed journals and MEDCOM funded projects[3-9]. The number of keywords under the technology categories (Technology, Information Technology Bandwidth, Information Formats, Standards and Modality Type) has expanded due to rapid technological developments. Keywords of medical specialties using telemedicine applications are not shown.

Table 3. Results of Review of Funded MEDCOM Telemedicine FY00 / FY01 Projects

This table summarizes some of the problems encountered by principal investigators that contributed to the difficulty in achieving optimal research outcomes. In the fourteen projects without outcomes (*), the principal investigator did not complete the proposed research at the end of the project.

Table 4. Security Access for the TIAC ISS

User Groups can be assigned to view files for levels A through E. Level A grants full access, while level E permits access to only non-secure files. Additional levels of File Access and User Groups can be developed to meet future needs. Note: X* is personalized file access. COTR** is the Contracting Office Technical Representative.

Table 1. References for TIAC Bibliographic Database[3-9]

Source	References (Citations)	Authors	Keywords	Publication Years
Telemedicine/Telehealth Symposium	333	841	49	31
PubMed 1990	5	7	33	1
PubMed 1991	3	5	15	1
PubMed 1992	54	120	225	2
PubMed 1993	68	144	262	2
PubMed 1994	112	231	39	3
PubMed 1995	277	623	602	3
PubMed 1996	366	764	732	3
PubMed 1997	510	1,063	864	3
PubMed 1998	721	1,577	1,121	5
PubMed 1999	804	1,958	1,218	9
PubMed 2000	861	2,272	1,221	6
PubMed 2001	797	2,037	1,323	14
PubMed 2002 (Up to May 7, 2002)	212	609	622	6
Total	**5165**			

The TIAC bibliographic database includes a total of 5165 references specifically compiled from PubMed and subject matter expert information from peer-reviewed sources. The PubMed keywords are found in the NLM search engines. Other TIAC keyword taxonomy was developed from subject matter expert information resources.[3-9]

Table 2. TIAC Generated Telemedicine Taxonomy and Structure[3-9]

Categories
Diagnosis
Education
Health Care Administration
Public Health
Research
Therapy

Technology
Digital
  Audio
  Communications (e-mail)
  Imaging
  Video
Multimedia Computing
Telecommunications
A. Platform
  Cable
  Fax
  Land Lines
  Microwave
  Radio Frequency
  Satellite
  Web
  Wireless
B. Modes
  Real-time (VTC)
  Store / Forward
Video
  Streaming
  Compression

E-Business Pillars
E-Administration
E-Commerce
E-Health
Knowledge Management

Information Technology Bandwidth
Connectivity
Data Distillation
Human-Computer Interaction
Storage, Processing, Compression

Information Formats
Data (Texts)
Images (Graphics)
Video
Virtual Reality
Voice (sound)

Standards
DICOM (Radiology)
Medical Information Exchange
Telemedicine Evaluation Plan

Maturity
Emerging
Mature
Maturing

Modality Type
Bandwidth
  ATM
  Cable
  Frame Relay
  ISDN
  Satellite
  T1, T2, T3, Fractional
  XDSL
E-Health
Format
  Digital
  Analog
HIPAA Compliant
List Servers
Wireless
Operating System
  CE
  Windows
  Palm OS
  E-mail
PDA
Physiological Data
Store and Forward
Teleradiology
Video Conferencing
Web Collaboration
  Web Boards
  Web-based Bulletin Boards

This table shows telemedicine keywords grouped according to taxonomy that the TIAC identified from peer-reviewed journals and MEDCOM funded projects[3-9]. The number of keywords under the technology categories (Technology, Information Technology Bandwidth, Information Formats, Standards and Modality Type) has expanded due to rapid technological developments. Keywords of medical specialties using telemedicine applications are not shown.

Table 3. Results of Review of Funded MEDCOM Telemedicine FY00 / FY01 Projects

	FY00	FY01	FY00	FY01
Total number of projects	16	20		
Projects without Outcomes *	6	8	Number in each Category	Number in each Category
Problems encountered by Principal Investigators (PI)				
1. Delay in IRB approval			7	9
2. Inadequate coordination with Information Services			11	7
3. Inadequate / Incomplete literature Review by PI			5	6
4. Cost of Project: Inadequate funding for project (manpower requirements not included)			16	20
5. Administrative oversight and technology infrastructure shortcomings			4	5
6. Results already found in previously published literature			3	1

This table summarizes some of the problems encountered by principal investigators that contributed to the difficulty in achieving optimal research outcomes. In the fourteen projects without outcomes (*), the principal investigator did not complete the proposed research at the end of the project.

Table 4. Security Access for the TIAC ISS

File Access / User Groups	1	2	3	4	5	6	7	8
A - TIAC Staff and COTR**	X	X	X	X	X	X	X	X
B - Government Personnel		X	X		X*	X		X
C - Civilian Subscribers		X	X		X*	X		X
D - Registered Civilians			X		X*	X		
E - General Public			X					

User Groups can be assigned to view files for levels A through E. Level A grants full access, while level E permits access to only non-secure files. Additional levels of File Access and User Groups can be developed to meet future needs. Note: X* is personalized file access. COTR** is the Contracting Office Technical Representative.

Figure Titles and Captions

Fig 1. TIAC Information Support System (ISS)

The TIAC Information Support System (ISS) is part of a virtual private network (VPN) that is separate from the Rush University Internet connections. Only the Bibliographic Data Base (1), the Project Data Base (2), the Public Web Site (3) were implemented during the pilot project to demonstrate proof of concept.

Fig. 2. TIAC Database: Migration to Maturity

The TIAC pilot program uses Reference Manager™, a non-relational bibliographic database software program, due to cost considerations. The mature TIAC will use Oracle™ database software.

Fig. 3. Secure TIAC Network (STN)

This figure shows the design of the Secure TIAC Network (STN) and its relationship to the TIAC ISS. It also shows the isolation of the TIAC components from the Rush network and the Internet.

Fig. 4. TIAC Public Website

The TIAC public website layout was designed according to the web design of mature IAC public websites sponsored by DTIC.

Fig. 5. Bibliographic Inquiry Request Form

This figure shows the bibliographic inquiry form created as a webpage on the public TIAC website. All text box information is mandatory in order to generate an inquiry to the TIAC. Principal investigators should provide specific bibliographic or technical questions that need to be answered by TIAC staff under the "Goals" section. The "Keyword" section should contain a list of the keywords selected by the principal investigator that relate to the project.

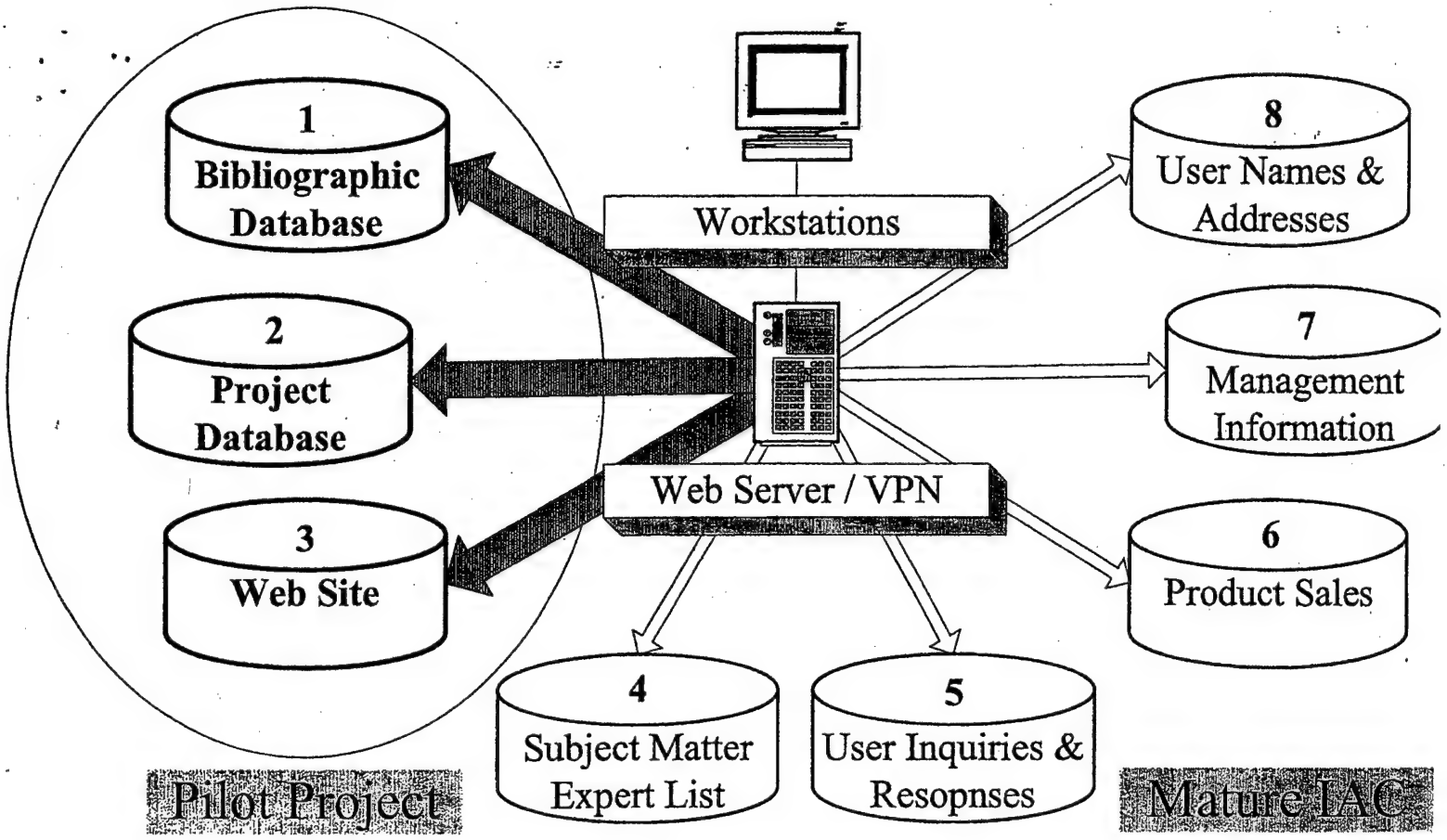
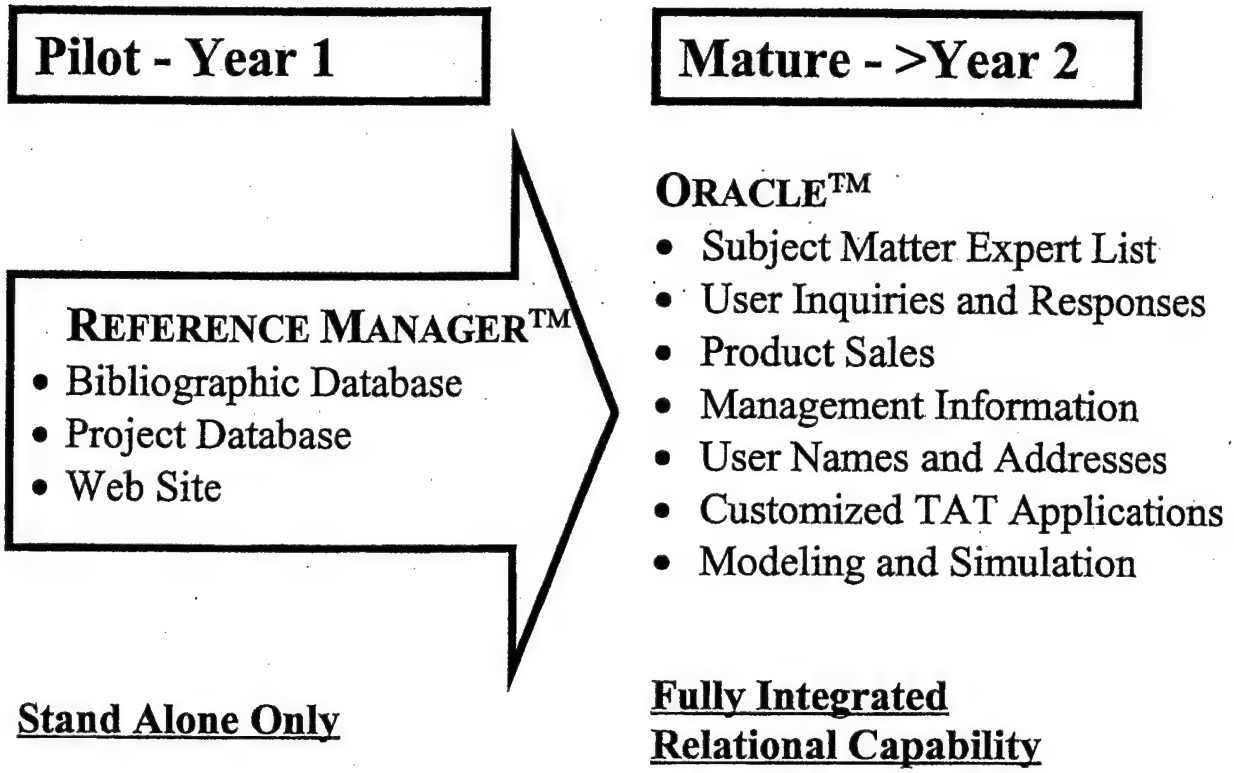


Fig 1. TIAC Information Support System (ISS)

Fig. 2. TIAC Database: Migration to Maturity



Commercial Off-The-Shelf (COTS) Software

The TIAC pilot program uses Reference Manager™, a non-relational bibliographic database software program, due to cost considerations. The mature TIAC will use Oracle™ database software.

Fig. 2. TIAC Database: Migration to Maturity

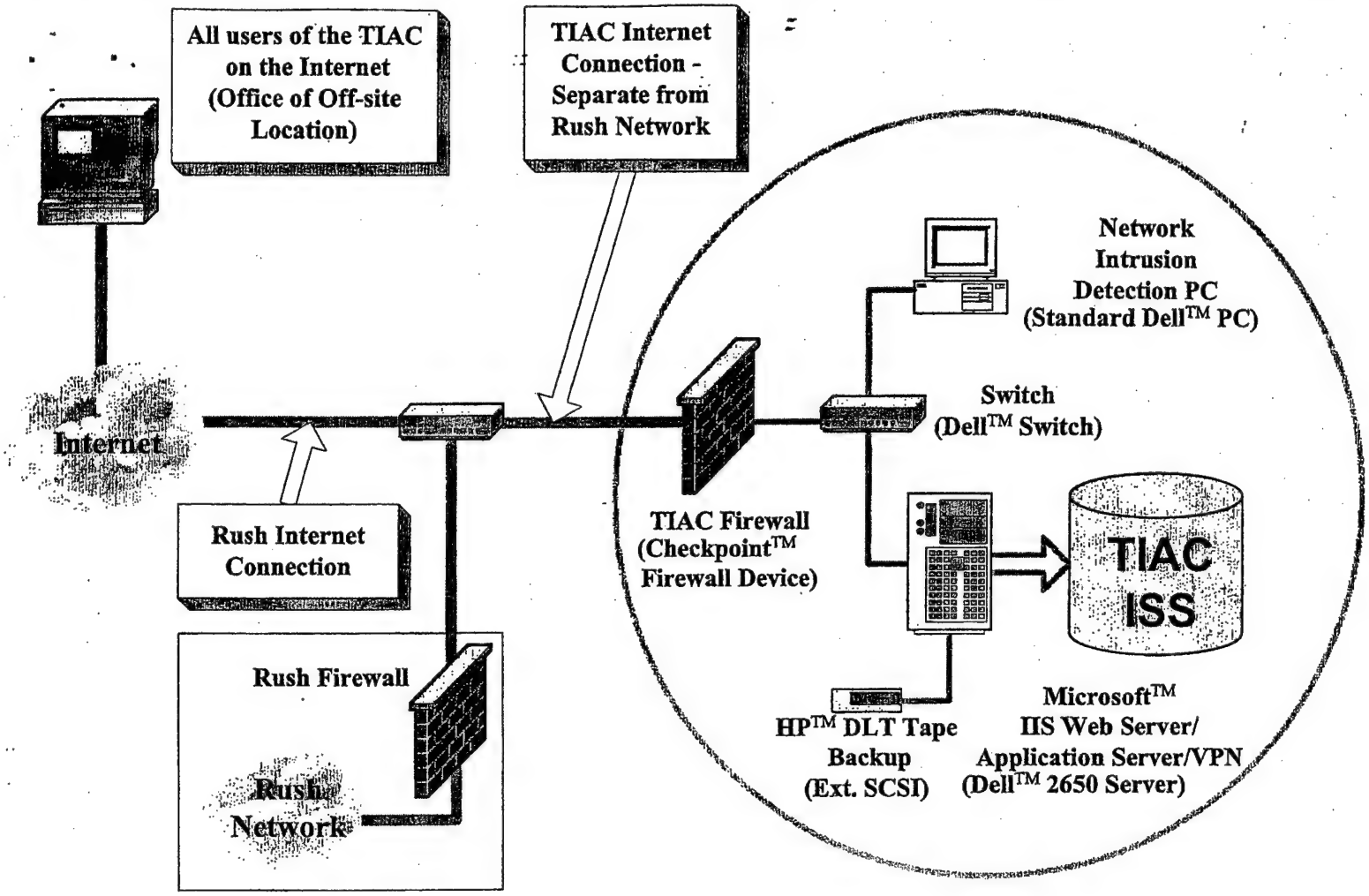


Fig. 3. Secure TIAC Network (STN)

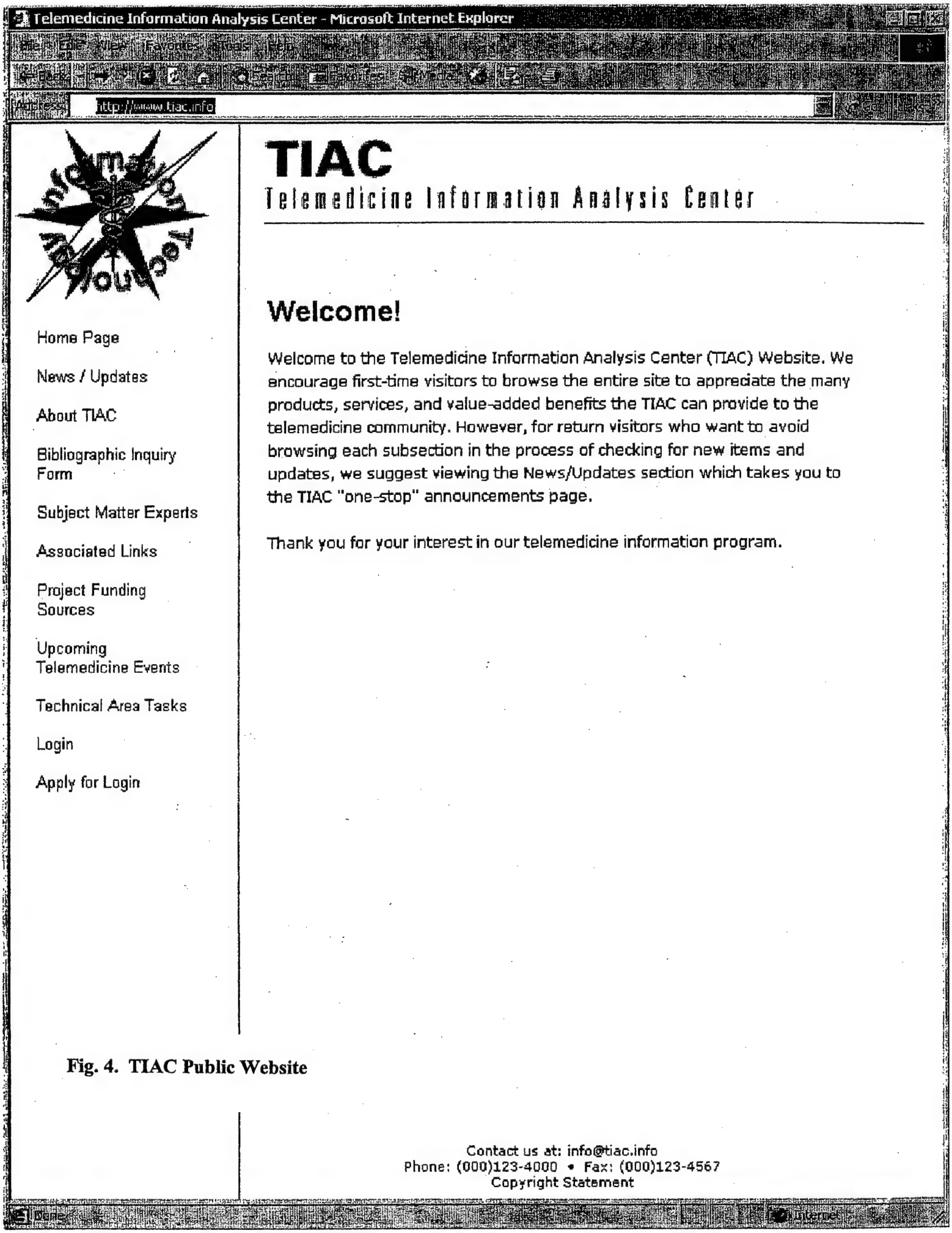


Fig. 4. TIAC Public Website

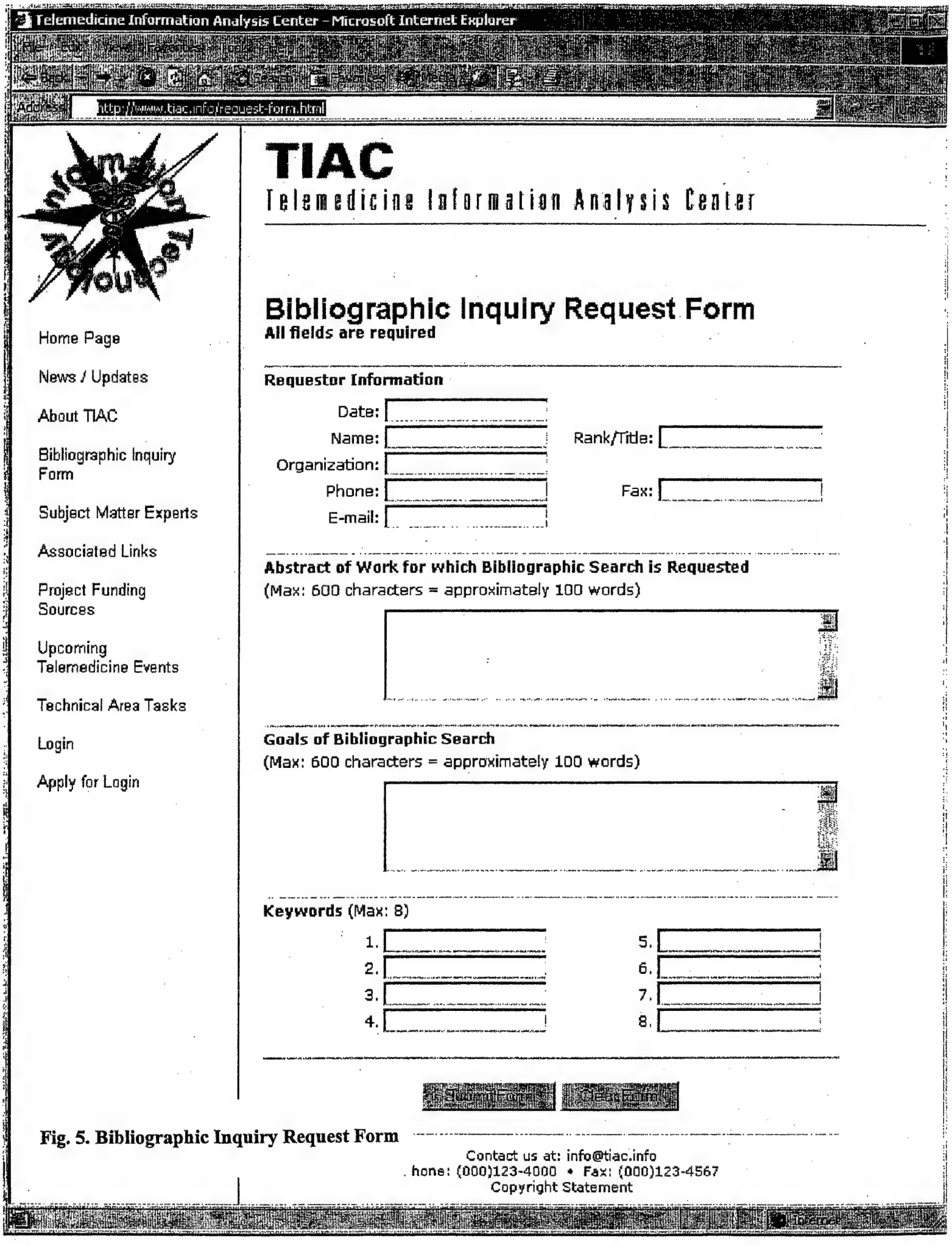


Fig. 5. Bibliographic Inquiry Request Form

Appendix B
TIAC Paper Presented at ATA Symposium
Slides and Handouts

TIAC Paper Presented at ATA Symposium
Slides

TELEMEDICINE INFORMATION ANALYSIS CENTER (TIAC)

FEB 11 , 2002 - APR 30 , 2003

AWARD NO . DAMD - 17 - 02 - 2 - 0020

RUSH - PRESBYTERIAN - ST. LUKE'S MEDICAL CENTER
RUSS ZAJTCHUK , MD
JOAN T. ZAJTCHUK , MD
RYAN P. GUTZ , BA , INFORMATION SVCS DIV.
BENJAMIN D. WALRATH , BA

INTELEDATICS, INC.
JOSEPH J. PETROVIC , MSEE

1

TELEMEDICINE INFORMATION ANALYSIS CENTER (TIAC):Pilot Project

Sponsor: The Telemedicine and Advanced Technology Research Center (TATRC)

Presented by:

Rush Consortium

1. Rush-Presbyterian-St. Luke's Medical Center, 707 S. Wood St., Suite 220, Chicago, IL 60612 Phone: (312) 942-6348 Fax: (312) 942-4293

Principal Investigator: Russ Zajtchuk, MD (e-mail: Russ_Zajtchuk@rush.edu)

Technical Area Leader : Joan Zajtchuk, MD (Joan_Zajtchuk@rush.edu)

Information Services Division: Ryan P. Gutz, BA (Ryan_P_Gutz@rush.edu)

Rush Medical College, MS II: Benjamin D. Walrath, BA (Benjamin_Walrath@rush.edu)

2. InteleDatics, Inc.:

Co-Director: Joseph J. Petrovic, MSEE (e-mail: jpetrovic@inteledatics.com)

A pilot study was conducted to determine the feasibility of establishing a Department of Defense Information Analysis Center for telemedicine. This study is sponsored by the Telemedicine and Advanced Technology Research Center (TATRC) of the US Army Medical Research and Materiel Command (USAMRMC) and conducted by the Center for Advanced Technology at Rush Presbyterian-St. Luke's Medical Center (RUSH) and its consortium partner InteleDatics, Inc.

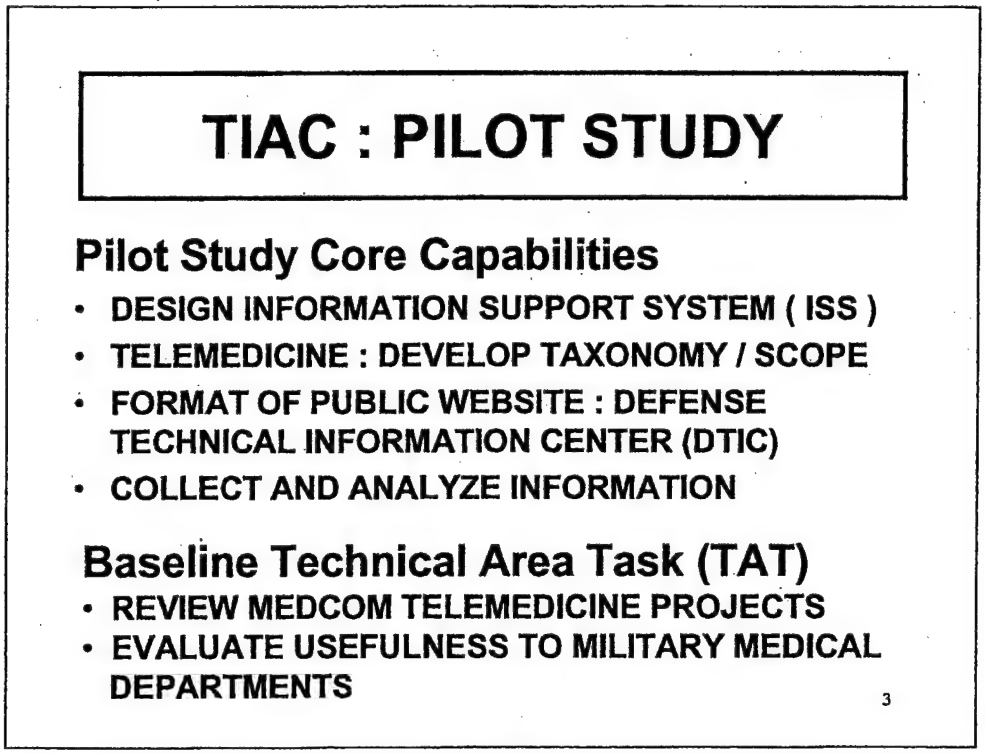
BACKGROUND

- **GAO Report to Congress (Feb 1997)**
  - ➡ TELEMEDICINE DEVELOPMENT : NO FORMAL MECHANISM / OVERALL STRATEGY EXISTS FOR FEDERAL AGENCY COORDINATION
  - ➡ NO FIRM BASIS FOR INFORMATION EXCHANGE
- **Congressionally Mandated (2001)**
  - ➡ CONDUCT PILOT STUDY : DETERMINE THE FEASIBILITY OF ESTABLISHING A DEPARTMENT OF DEFENSE INFORMATION ANALYSIS CENTER FOR TELEMEDICINE (TIAC)

2

Congressional Language: "Sec 315. Of the total amount appropriated by title IV of the Department of Defense Appropriations Act, 2001 (Public Law 106-259) under the heading "Research, Development, Test and Evaluation, Army,"....and not less than $1,000,000 shall be made available only to conduct a pilot study to determine the feasibility of establishing a Department of Defense Information Analysis Center for telemedicine."

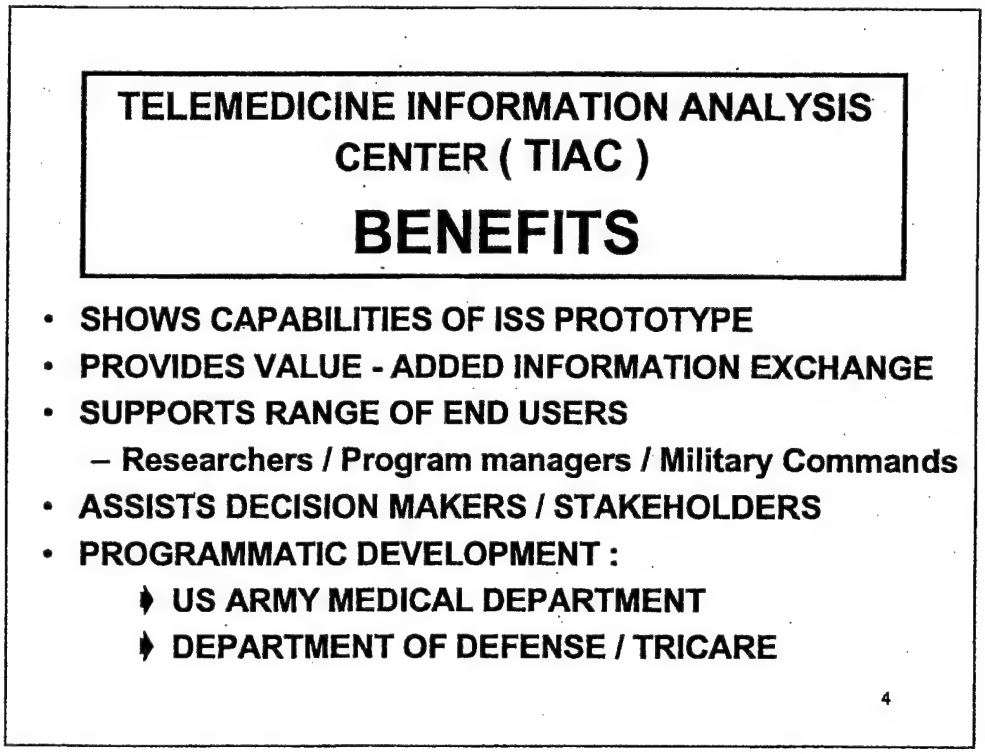
Requirements: In a report to Congress in 1997, the General Accounting Office (GAO) recommended that Federal Strategy be developed to guide investments in the field of telemedicine. The report calls on the Department of Defense to help forge a government-wide strategy for using and gauging success of telemedicine technology in the federal area. In 2001 Congress directed DoD to conduct a pilot study to determine the feasibility of establishing a Department of Defense Information Analysis Center for telemedicine with the goal of maximizing return on investment and develop better coordination and exchange of information and analysis of telemedicine projects.



TIAC Pilot Core Capabilities: The pilot project establishes the feasibility of a TIAC core program. Core capabilities include (a) applying the science of classification (taxonomy) to identify key words used in telemedicine; (b) creating a relational database using these key words in the taxonomy to a telemedicine bibliographic database; (c) providing analyses by subject matter experts for clinical and information technology queries; (d) developing a public TIAC web site to disseminate TIAC reports and (e) performing a baseline technical area task (TAT).

Baseline MEDCOM TAT: Past funded clinical research telemedicine projects under TATRC sponsorship (USAMRMC's MEDCOM Telemedicine Initiative that includes Triservice representation) were reviewed to evaluate their utility to the MEDCOM. The RUSH Consortium was directed to analyze proposed and funded telemedicine projects for the FY00, FY01 periods. The projects were evaluated for meeting their goals, and for their usefulness. Recommendations were made on ways to improve the funding selection process, the relative value of the "return on investment," and the role TIAC can play in achieving these results. All MEDCOM projects were classified according to the Army Medical Department's e-Business strategy and the level of maturity that medical specialties incorporated telemedicine technology into main-stream business practices.

The TIAC provides authoritative telemedicine information relative to key R&D concepts, results, and trends; applications and processes; and assessment of national and international R&D technology. The pilot TIAC staff monitors and extracts information from final reports and other material, including but not limited to, the science, technology, and acquisition of telemedicine systems technology and related training, analyses, databases, model repositories, laboratory studies, testing, hardware, components, systems, and subsystems.

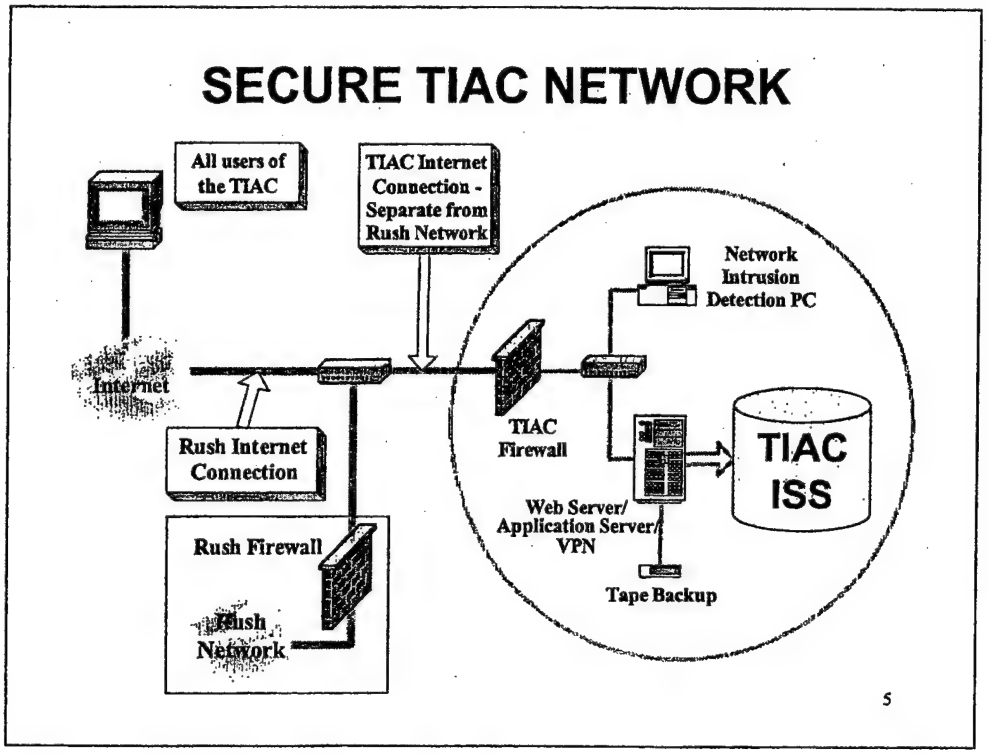


BENEFITS

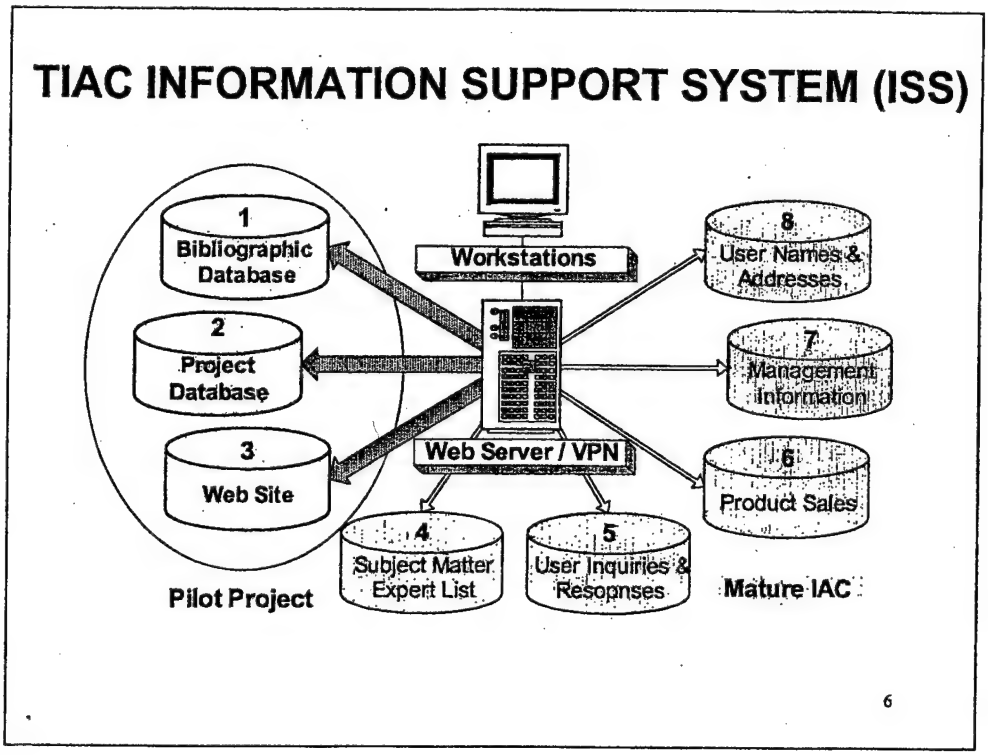
One of the benefits of conducting the pilot program is to demonstrate the structure and use of the expanded telemedicine bibliographic database, the main component of the Information Support System (ISS). The expanded taxonomy developed for this database provides search links between documents and other information sources from public and private entities such as models, simulations, test results, etc. The taxonomy encompasses the elements defining the scope of telemedicine.

Perhaps the most important benefit of the pilot program is demonstrating value-added information that will be available to end users and decision-makers. In addition to the efficient search capabilities of the bibliographic database available to the TIAC staff, a consortium of Subject Matter Experts (SMEs) will provide expert responses to technical inquiries. Areas in which the SMEs can provide (hard-to-find) information include:

- policy considerations
- corporate memory



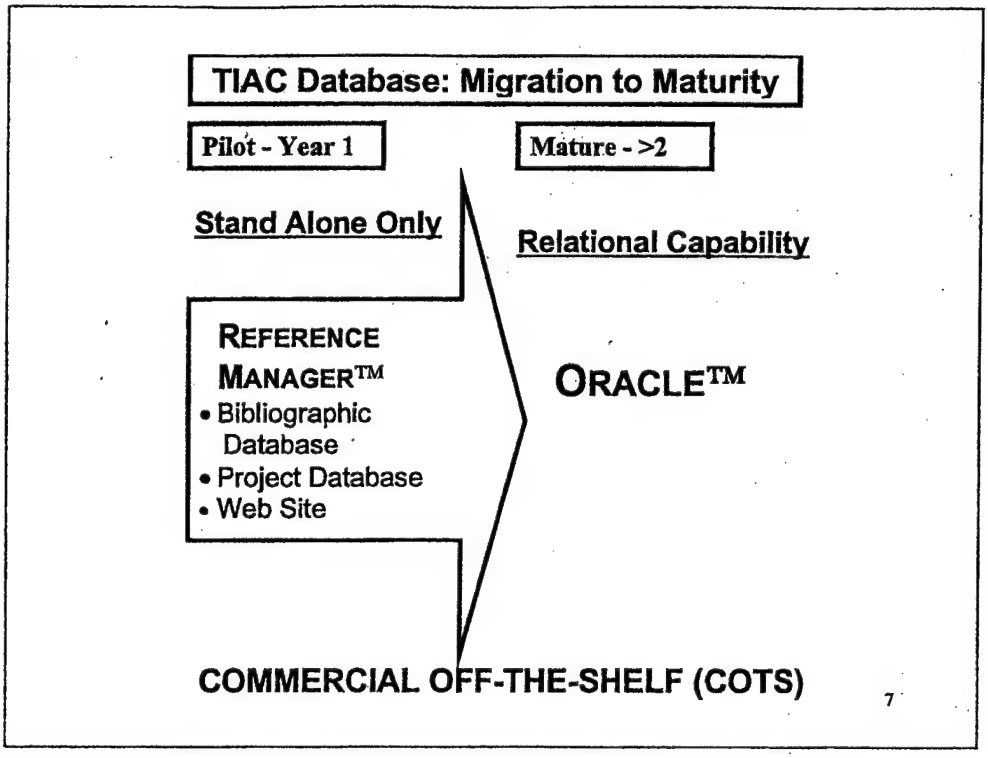
A configuration of hardware and software selected for the STN, allows a proof of concept demonstration using commercial-off-the-shelf (COTS) items. The VPN provides access at any site for the TIAC staff to the bibliographic database and files and also provides the ability to maintain the web server remotely. A dedicated firewall device connects the TIAC STN to the Internet. This firewall is directly attached to Rush's incoming Internet connection and is completely separate from Rush Medical Center's hospital network.



Information Support System (ISS)

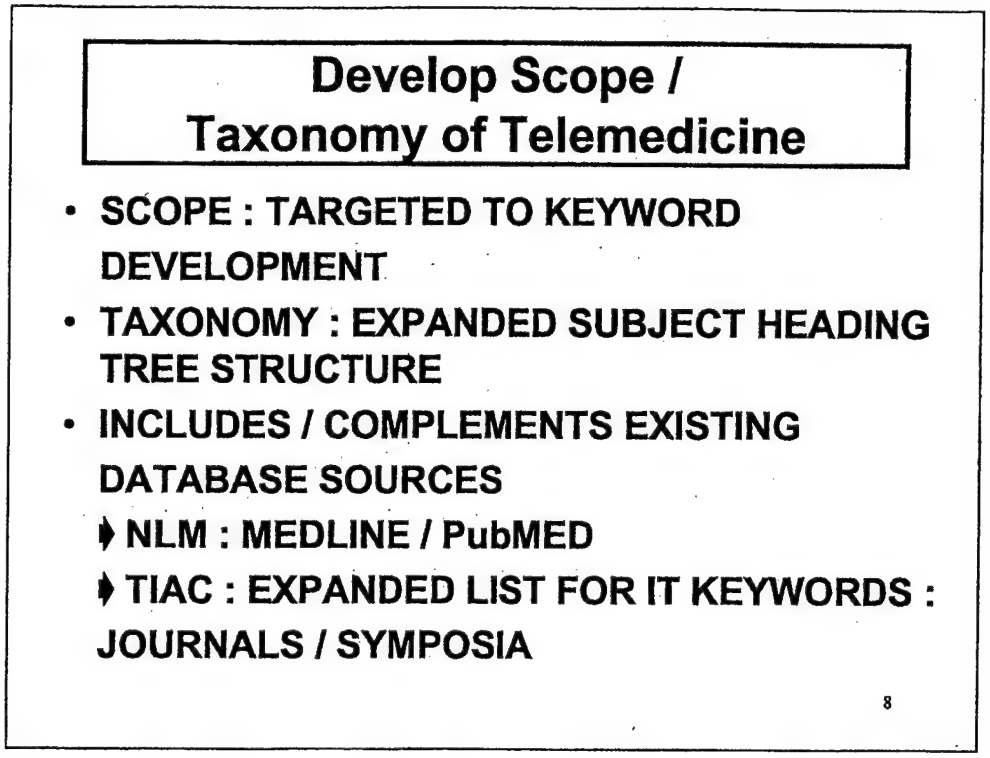
A rudimentary Information Support System (ISS) was developed under the pilot program based on the standard components found in an IAC ISS. A bibliographic database, public web site, and project database are included in this ISS to demonstrate proof of concept. The ISS is part of a Secure TIAC Network (STN) developed that will permit controlled access to files of a sensitive nature that are stored in the TIAC. The access to controlled data is achieved via a virtual private network (VPN) and SSL pages.

Concept development and proof of concept of the ISS/STN is being developed under the pilot TIAC study as a prototype of a secure network. The isolation of the secure network can be easily done within large information management systems as was demonstrated at Rush.



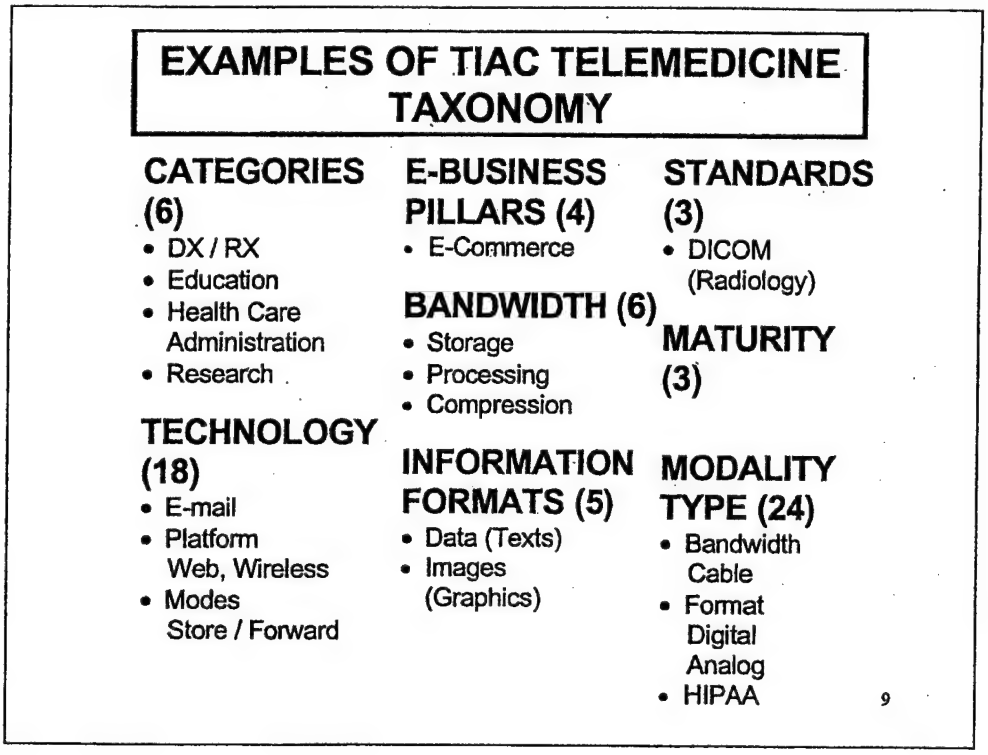
The database application used for the mature TIAC will be ORACLE™ The database program used in Years 2-3 and beyond (ORACLE™) is a relational database that incorporates features that are desirable for bibliographic applications. However, the cost and complexity of an ORACLE™ database program was not justified for the pilot program for the ISS where funds were limited. The COTS product selected for the pilot study, Reference Manager™, is not a relational database. However, the database structure has been conceived and designed to achieve the equivalent performance of a relational system. The requirements of the database usage are just now being experimentally defined and tested using bibliographic queries for a limited number of MEDCOM projects.

The pilot program approach therefore was to use an inexpensive, simple, commercial-off-the-shelf (COTS) program such as Reference Manager™ to determine the structure and expected capacity needed for the mature TIAC database. All material of the initial database would be migrated to ORACLE™ programs when the level of resources (funds and staffing) become adequate.



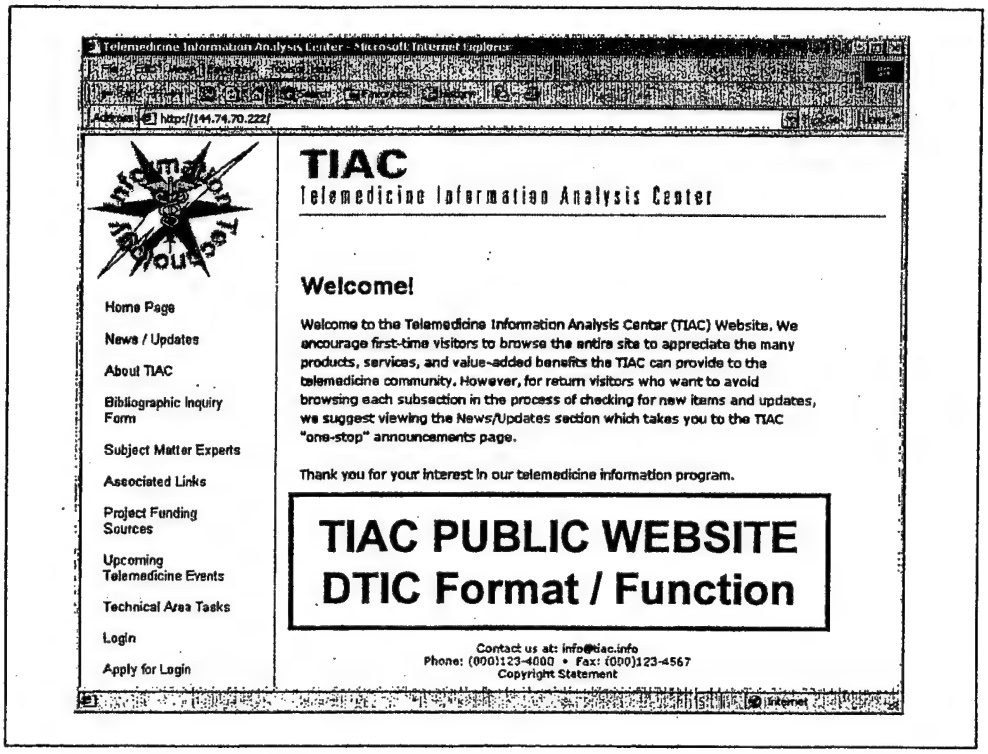
The scope of telemedicine was investigated under the pilot program. Therefore, the primary effort is to create and adopt a collection of universally accepted technical keywords and to categorizing these keywords into a logical structure to link related information. This is the primary role of defining and accepting a robust taxonomy of telemedicine into common use. The science of taxonomy is being applied to telemedicine in order to facilitate searches for related information.

The TIAC is not developing a new information database source for telemedicine, but is linking to the NLM, a well-established resource familiar to and accepted by the medical community. The clinical use for telemedicine applications in medicine, although very broad in range, is well established in terms of terminology and categorization in the National Library of Medicine (MEDLINE/PubMed) databases. However information technology terminology, the underpinning of telemedicine applications, is evolving at a very rapid rate and there is a paucity of telemedicine terminology in the NLM MeSH tree structure. New technical terminology is growing rapidly with the increased applications of information technology in healthcare and computer system innovations.. The structure for the technology aspects of telemedicine terminology is being developed in the TIAC to link to the NLM search engines. The TIAC pilot showed the need to expand the NLM database, by compiling a telemedicine vocabulary from a limited search of peer-reviewed references. These references represent past and current documents that are frequently cited as excellent source material. The TIAC staff is comparing the telemedicine keywords in these references with those in the MeSH categories in the NLM. The TIAC recommended that the NLM consider expanding the MeSH categories in their database.



A preliminary step in testing the core capabilities of the TIAC is to develop the taxonomy of telemedicine. Therefore, the primary effort was to create and adopt a collection of universally accepted technical keywords and to categorize these keywords into a logical structure to link related information. This is of importance in accepting a robust taxonomy of telemedicine for common usage. The science of taxonomy is being applied to telemedicine in order to facilitate searches for related information. The TIAC developed a telemedicine taxonomy structure by creating a keyword list using several compiled telemedicine resources. The references selected represent past and current documents that have been used frequently as source material.

Ultimately the telemedicine community should convene an expert panel to review and further develop the taxonomy of telemedicine using standardized keywords. The process would incorporate both the technical and clinical elements of telemedicine terminology for adoption for standard usage. The standardization and acceptance of these keywords by both the telemedicine community and within the NLM search engines would greatly facilitate retrieval of bibliographic references by researchers in the field.



Notes about the TIAC Website

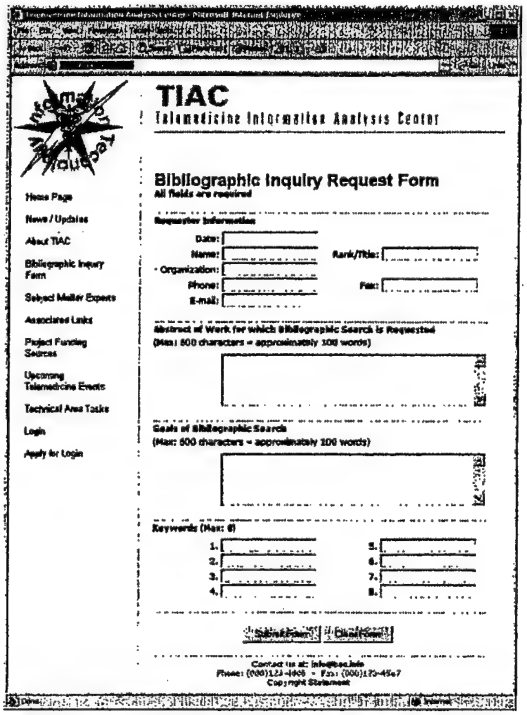
The utility of a TIAC ISS that can be accessed through a website shows its value in reduced costs and ease of use. By logging into a website with COTS browsers like Internet Explorer™, users can initiate a secure connection to download files or view sensitive information via Secure Sockets Layer (SSL). Queries can be sent via a secure web page form that generates an e-mail sent to the TIAC staff. Since the majority of users have experience navigating the Internet, investment in training and familiarization will be kept to a minimum. All security and logins are administered centrally from the TIAC servers.

Summary of benefits with this model:

- Users are not required to buy additional hardware or software
- Users are not required to install and configure software
- The learning curve is potentially lower by using an Internet interface vs. a proprietary client program
- There is no infrastructure for users to establish and manage; access is nearly universal from any desktop using an Internet connection and browser
- Easiest and cheapest way to electronically connect people to the TIAC

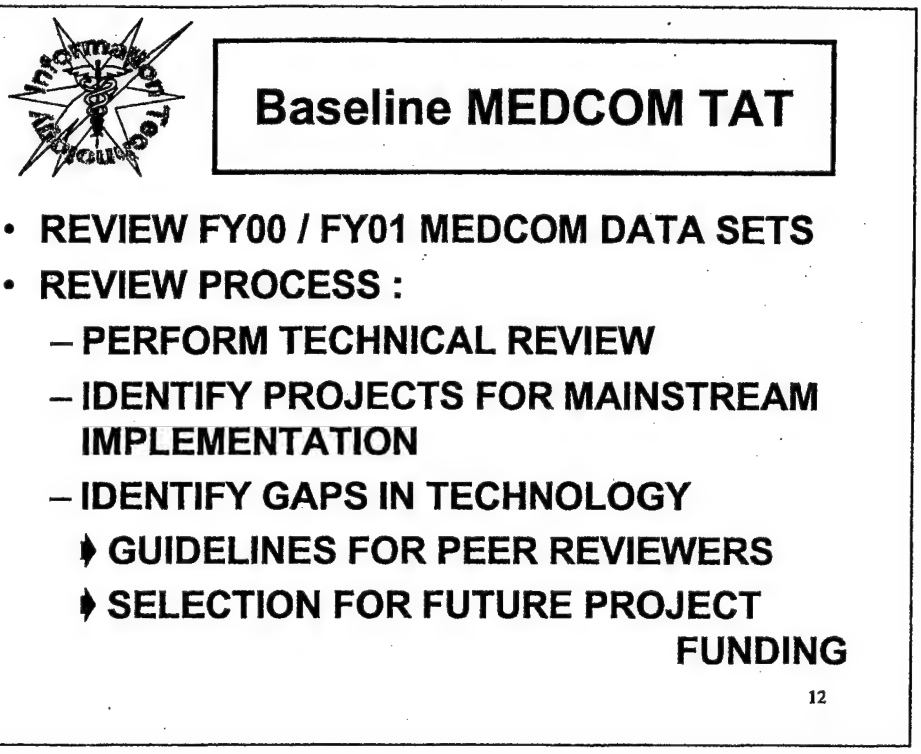
BIBLIOGRAPHIC INQUIRY REQUEST WEB FORM

- **REQUESTOR INFORMATION**
- **ABSTRACT OF WORK**
- **BIBLIOGRAPHIC SEARCH GOALS**
- **KEYWORDS**



The TIAC can provide the following assistance to researchers in the future. As an example, at the beginning of the project planning, the principal investigator can complete a bibliographic inquiry form via the public TIAC webpage to ask specific technical or clinical questions of the TIAC staff. The TIAC staff then queries the TIAC bibliographic database and provides a list of pertinent references to assist the principal in planning the project. A second inquiry should also be done at the middle and end of the project so as to incorporate the most recent literature references into the project conclusions.

A limited number of basic queries were retrospectively done by the TIAC staff using the TIAC bibliographic database on 8 projects in FY00 and 11 projects in FY01. Key words were identified in the principal investigator's abstract and used to ascertain the completeness of the cited references.



TIAC Technical Area Task

Baseline MEDCOM Technical Area Task

A baseline Technical Area Task (TAT) was conducted as part of the pilot study. The objective of the TAT is evaluating the utility to Service medical departments of results from past MEDCOM telemedicine projects. Programs conducted under the USAMRMC's MEDCOM Telemedicine Initiative were selected for this evaluation. Under this TAT the RUSH Consortium was directed to review and analyze proposed and selected projects for the FY00 and FY01 funding periods. The projects were evaluated for completeness and utility and suggestions were made on ways of improving the procedures and the "return on investment" along with the TIAC's role in achieving these improvements.

TAT RESULTS: FUNDED MEDCOM FY00 /FY01

	FY00	FY01
TOTAL # PROJECTS	16	20
# W /O DELIVERABLES	6	8

INVESTIGATOR PROBLEMS / CATEGORY		
1. IRB DELAY	7	9
2. IMO COORDINATION	11	7
3. LITERATURE SEARCH	5	6
4. MANPOWER COSTS	16	20
5. TECH INFRASTRUCTURE	4	5
6. DUPLICATED RESEARCH	3	1

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Review and analysis revealed that of the thirty-six funded projects, fourteen were not completed and therefore produced no meaningful results. Several factors appear to be responsible for the lack of project outcomes. Some of the causes include a) delay in Institutional Review Board approval; b) inadequate coordination of project requirements with Information Services personnel; c) inability to do a thorough bibliographic search due to lack of standardization and usage of telemedicine keywords as would be found in a robust taxonomic structure; d) manpower costs were underestimated; e) existing technology infrastructure that required new acquisitions or modifications; and f) hypothesis already proven in previous research. No significant improvement in these parameters was noted between FY00 and FY01.

TIAC SUMMARY

- TIAC : " IN - HOUSE " EXPERTISE
- TECHNOLOGY EFFECTIVENESS / CLINICAL EFFICACY
- BENEFITS RESEARCHERS / PROGRAM MANAGERS / DECISION MAKERS
- DEFINES SCOPE / STANDARDIZES KEYWORDS
- FUNCTIONS : DITC IAC FORMAT & REQUIREMENTS

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Perhaps the most important benefit of the pilot program is demonstrating value-added information that will be available to end-users and decision-makers. In addition to the efficient search capabilities of the bibliographic database, the TIAC staff also has a consortium of Subject Matter Experts (SMEs) that can provide expert responses to technical inquiries. These experts can act in an advisory role to develop strategies to insert telemedicine applications into the Triservice military medical department and other healthcare organization structures. TIAC can also support Service decision-makers in designing a more programmatic approach matched to service requirements. The MHS information technology investment decisions are based on input from Triservice working groups with limited first-hand knowledge of the complex systems under consideration for implementation. The recommendations of these working groups are then referred to senior medical leadership for validation and ultimate approval or modification. Without consistent access to objective, standardized benchmarked project profiles, these decisions may not yield the best enterprise solutions. Similarly, next-generation R&D projects are often chosen based on successful subject lobbying efforts. Standardized project profiles will improve the objectivity of this selection process. Although conceived as a DoD resource, the TIAC can serve as a global resource for the telehealth scientific community by a) developing technical and clinical standards; b) enhancing the productivity and effectiveness of researchers and clinicians; c) identifying best information technology applications for incorporation into main-stream medical practice and business models; and d) expanding and standardizing the key words for telemedicine in the National Library of Medicine search engines.

CONTACT INFORMATION (TIAC)

Rush Consortium Members

• Rush - Presbyterian - St. Luke's Medical Center
Russ_Zajtchuk@rush.edu
Joan_Zajtchuk@rush.edu
Ryan_P_Gutz@rush.edu (IT Div.)

• InteleDatics , Inc.
jpetrovic@inteledatics.com

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TIAC Paper Presented at ATA Symposium
Handouts

TELEMEDICINE INFORMATION ANALYSIS CENTER (TIAC)
Feb 11, 2002 - Apr 30, 2003
Award No. DAMD - 17 - 02 - 2 - 0020

Rush Consortium Members
Rush-Presbyterian-St. Luke's Medical Center (RPSLMC)
Russ Zajtchuk, M.D.
Joan T. Zajtchuk, M.D.
Ryan P. Gutz, BA, Network Analyst, Information Services Division
Benjamin D. Walrath, BA
InteleDatics, Inc.
Joseph J. Petrovic, MSEE

1

Background

- **GAO Report to Congress (GAO / NSIAD / HENS-9767, February 1997):**
  ... " no formal mechanism or overall strategy exists to ensure that telemedicine development is fully coordinated among federal agencies to serve a common purpose. No firm basis exists for information exchange."
- **Congressionally mandated (Dept of Defense Appropriations Act, 2001 (Public Law 106-259)**
  ... " to conduct a pilot study to determine the feasibility of establishing a Department of Defense Information Analysis Center for telemedicine."

2

TIAC : PILOT STUDY

Pilot Study Core Capabilities
- Design, implement and initially populate the Information Support System (ISS) bibliographic database
- Develop taxonomy and scope of Telemedicine
- Establish TIAC Intranet and Public TIAC Website
- Collect and analyze information

Baseline MEDCOM Technical Area Task (TAT)
- Review results / products of past MEDCOM telemedicine projects
- Evaluate usefulness to Service Medical Departments (applications for mainstream health care business practices)

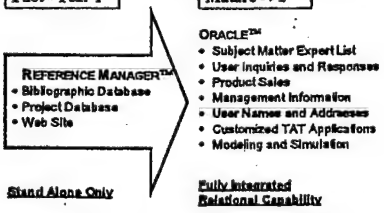
3

TELEMEDICINE INFORMATION ANALYSIS CENTER (TIAC)

BENEFITS
- Demonstrate core capabilities of ISS prototype
- Provide value-added exchange of information (clinicians, technology developers, and end users)
- Support full range of end users
  - Research bench engineers / PI clinicians / IMO
  - Program managers (Regional Commands / MEDCENS)
- Expected future benefits: assists decision makers / stakeholders
  - Medical: SGO / Asst. Secretary of Defense, Health Affairs (Trisservice oversight)
  - US Army: PA & E (Identify technologies, projects, protocols for programmatic development)

4

TIAC Database: Migration to Maturity



Commercial Off-The-Shelf (COTS) Software

5

PILOT STUDY
Develop Scope / Taxonomy of Telemedicine

- **Scope of Telemedicine Investigated**
- **Targeted to Technical Keyword Structure Development** (Taxonomy of Telemedicine Developed and Incorporated into Subject Heading Tree Structure)
- **Avoidance of creating new database source for telemedicine**
- **Links to well-established information centers**
  (e.g., National Library of Medicine (NLM)
  - MEDLINE/ PubMed databases of NLM Selected as Premier Source (Medical terminology well developed)
  - Paucity of technical telemedicine information terminology within Medical Terminology Categorization of NLM

6

Baseline MEDCOM TAT

Evaluate usefulness to Service Medical Departments :

Review FY00 / FY01 MEDCOM Data Sets

(Pre - proposal / Proposal / Interim Report / Final Report)

Review Process:

- Perform technical review
- Identify projects for mainstream implementation
- Identify gaps in technology (acts as evaluation guideline for peer reviewer / assists in selection of future projects)

TAT RESULTS: Funded MEDCOM FY00 / FY01

	FY00	FY01
Total # Projects	16	20
# Without Deliverables	6	8

Investigator Problems	# In Each Category	
1. IRB Delay	7	9
2. IMO Coordination	11	7
3. Literature Search	5	6
4. Manpower Costs	16	20
5. Admin / Tech Infrastructure	4	5
6. Duplicated Research	3	1

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TELEMEDICINE INFORMATION ANALYSIS CENTER SUMMARY

- DoD-Wide Telemedicine Information Center
  - Collect, analyze, synthesize, and disseminate worldwide telemedicine information
  - Improve productivity of researchers, program managers, and decision makers
  - Characterize scope of telemedicine and promote standardization
  - Includes in-house expertise to assess technology effectiveness and clinical efficacy of telemedicine
- Functions Structured under DTIC Information Analysis Center Format
- TIAC Pilot Study Design:
  Includes Generic Structure and Requirements of DITC IACs

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TIAC Contact Information

Rush Consortium Members

- Rush-Presbyterian-St. Luke's Medical Center (RPSLMC)

Russ Zajtchuk, M.D. Russ_Zajtchuk@rush.edu
Joan T. Zajtchuk, M.D. Joan_Zajtchuk@rush.edu
Ryan P. Gutz, BA, Ryan_P_Gutz@rush.edu
Network Analyst, Information Services Division
Benjamin D. Walrath, BA Benjamin_Walrath@rush.edu

- InteleDatics, Inc.

Joseph J. Petrovic, MSEE jpetrovic@inteledatics.com

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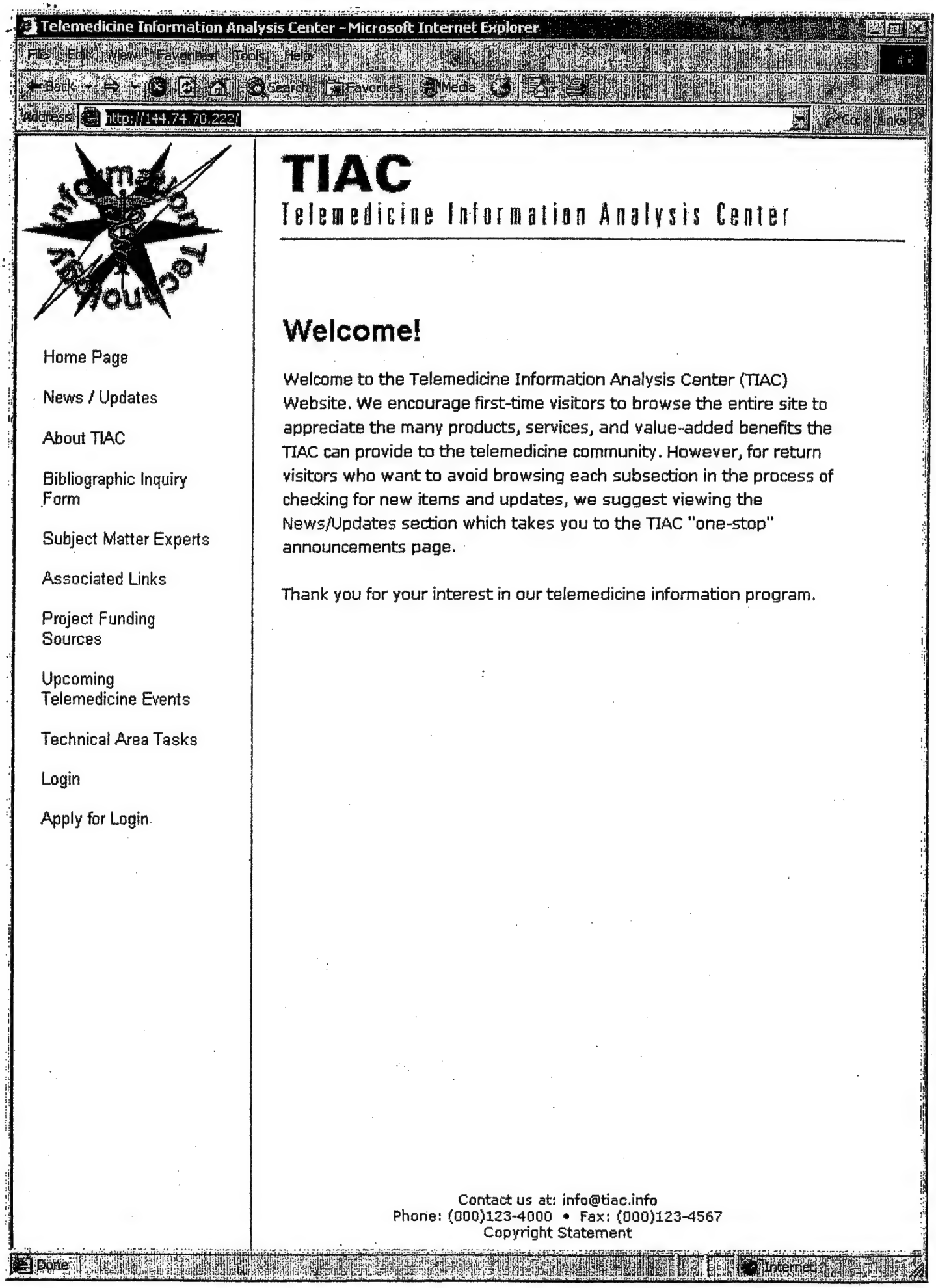
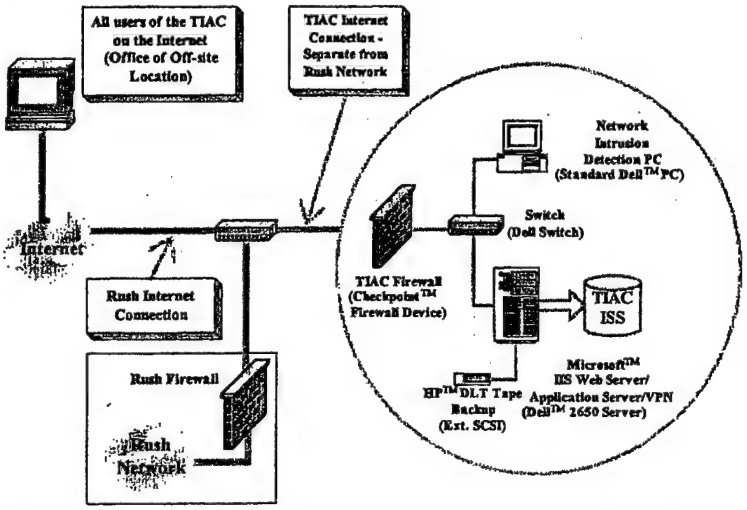
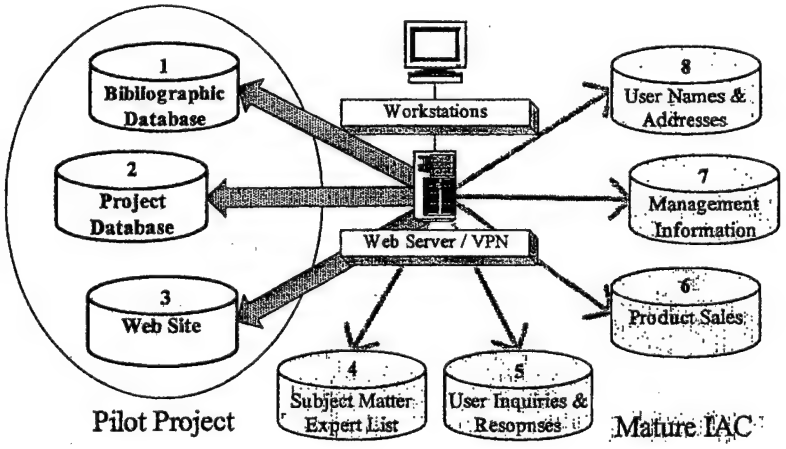

Telemedicine Information Analysis Center - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://144.74.70.223/
Links
TIAC
Telemedicine Information Analysis Center
Home Page
News / Updates
About TIAC
Bibliographic Inquiry Form
Subject Matter Experts
Associated Links
Project Funding Sources
Upcoming Telemedicine Events
Technical Area Tasks
Login
Apply for Login
Welcome!
Welcome to the Telemedicine Information Analysis Center (TIAC) Website. We encourage first-time visitors to browse the entire site to appreciate the many products, services, and value-added benefits the TIAC can provide to the telemedicine community. However, for return visitors who want to avoid browsing each subsection in the process of checking for new items and updates, we suggest viewing the News/Updates section which takes you to the TIAC "one-stop" announcements page.
Thank you for your interest in our telemedicine information program.
Contact us at: info@tiac.info
Phone: (000)123-4000 • Fax: (000)123-4567
Copyright Statement
Done
Internet

Secure TIAC Network



This figure shows the design of the Secure TIAC Network (STN) and its relationship to the TIAC ISS. It also shows the isolation of the TIAC components from the Rush network and the Internet.

TIAC Information Support System (ISS)



The TIAC Information Support System (ISS) is part of a virtual private network (VPN) that is separate from the Rush network. Only the Bibliographic Data Base (1), the Project Data Base (2), the Public Web Site (3) were implemented during the pilot project to demonstrate proof of concept.

Telemedicine Information Analysis Center - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites Media

Address http://144.74.70.222/

- Home Page
- News / Updates
- About TIAC
- Bibliographic Inquiry Form
- Subject Matter Experts
- Associated Links
- Project Funding Sources
- Upcoming Telemedicine Events
- Technical Area Tasks
- Login
- Apply for Login

TIAC

Telemedicine Information Analysis Center

Bibliographic Inquiry Request Form

All fields are required

Requestor Information

Date:

Name: Rank/Title:

Organization:

Phone: Fax:

E-mail:

Abstract of Work for which Bibliographic Search is Requested

(Max: 600 characters = approximately 100 words)

Goals of Bibliographic Search

(Max: 600 characters = approximately 100 words)

Keywords (Max: 8)

1. 5.
2. 6.
3. 7.
4. 8.

Submit Form Clear Form

Contact us at: info@tiac.info
Phone: (000)123-4000 • Fax: (000)123-4567

Done Internet

TIAC Generated Telemedicine Taxonomy and Structure[3-9]

Categories
Diagnosis
Education
Health Care Administration
Public Health
Research
Therapy

Technology
Digital
  Audio
  Communications (e-mail)
  Imaging
  Video
Multimedia Computing
Telecommunications
A. Platform
  Cable
  Fax
  Land Lines
  Microwave
  Radio Frequency
  Satellite
  Web
  Wireless
B. Modes
  Real-time (VTC)
  Store / Forward
Video
  Streaming
  Compression

E-Business Pillars
E-Administration
E-Commerce
E-Health
Knowledge Management

Information Technology Bandwidth
Connectivity
Data Distillation
Human-Computer Interaction
Storage, Processing, Compression

Information Formats
Data (Texts)
Images (Graphics)
Video
Virtual Reality
Voice (sound)

Standards
DICOM (Radiology)
Medical Information Exchange
Telemedicine Evaluation Plan

Maturity
Emerging
Mature
Maturing

Modality Type
Bandwidth
  ATM
  Cable
  Frame Relay
  ISDN
  Satellite
  T1, T2, T3, Fractional
  XDSL
E-Health
Format
  Digital
  Analog
HIPAA Compliant
List Servers
Wireless
Operating System
  CE
  Windows
  Palm OS
  E-mail
PDA
Physiological Data
Store and Forward
Teleradiology
Video Conferencing
Web Collaboration
  Web Boards
  Web-based Bulletin Boards

This table shows telemedicine keywords grouped according to taxonomy that the TIAC identified from peer-reviewed journals and MEDCOM funded projects[3-9]. The number of keywords under the technology categories (Technology, Information Technology Bandwidth, Information Formats, Standards and Modality Type) has expanded due to rapid technological developments. Keywords of medical specialties using telemedicine applications are not shown.

Appendix C
MEDCOM Project Queries
Bibliographic Search Specs

Appendix C
MECOM Project Queries
Bibliographic Search Specs

This appendix lists the specifications (specs) of the bibliographic searches or queries conducted for the MEDCOM Projects analyzed in the TIAC Baseline TAT. All searches were conducted on the PubMed databases. The search specs varied according to the title of the database and the search strategy structure. Examples of the variations in these specs are given below:

- Database Title
  - TM1999 (Telemedicine database for 1999)
  - TM2000 (Telemedicine database for 2000)
  - TM2001 (Telemedicine database for 2001)
- Search Strategy Structure
  - Field (e.g. author, keyword, etc.)
  - Connector (e.g. AND, OR, NOT)
  - Parameter (e.g., for the keyword field; ophthalmology, diagnosis, methods, etc

The PubMed databases for the years 1999, 2000, and 2001 were selected because they contain the current references for the MEDCOM projects during the proposal and research phases. The keyword field was used in all cases since this is the parameter most commonly associated with projects and references. The AND connector was used since this is consistent with a tree-structure categorization of keywords.

FY00 MEDCOM Projects

TIAC BIBLIOGRAPHIC SEARCH SPECS

Date:	3/27/2003
TIAC Program Task:	Demo B
MEDCOM Project:	FY00-0102
Database Source:	PubMed
Database Title:	TM1999
Search Strategy:	DemoB_FY00_0102_01

Search Strategy Structure

Field	Connector AND	Connector OR	Connector NOT	Parameter	* x
Keyword				Pediatrics	
Keyword	x			Infant, Newborn	

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

Date:	3/27/2003
TIAC Program Task:	Demo B
MEDCOM Project:	FY00-0102
Database Source:	Pub Med
Database Title:	TM2000
Search Strategy:	DemoB_FY00_0102-02

Search Strategy Structure

Field	Connector AND	Connector OR	Connector NOT	Parameter	* x
Keyword				Pediatrics	
Keyword	x			Infant, Newborn	

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

Date:	3/27/2003
TIAC Program Task:	Demo B
MEDCOM Project:	FY00-0102
Database Source:	Pub Med
Database Title:	TM2000
Search Strategy:	DemoB_FY00_0102-03

Search Strategy Structure

Field	Connector AND	Connector OR	Connector NOT	Parameter	* x
Keyword				Pediatrics	
Keyword	x			Remote Consultation	

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

Date:	
TIAC Program Task:	
MEDCOM Project:	
Database Source:	
Database Title:	
Search Strategy:	

Search Strategy Structure

Field	Connector AND	Connector OR	Connector NOT	Parameter	* x

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:	3/27/2003	Keyword				Asthma	
TIAC Program Task:	Demo B	Keyword	x			Remote Consultation	
MEDCOM Project:	FY00-0148						
Database Source:	Pub Med						
Database Title:	TM1999						
Search Strategy:	DemoB_FY00_0148-01						
	DemoB_FY00_0148-01						

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:	3/27/2003	Keyword				Chronic Disease	
TIAC Program Task:	Demo B	Keyword	x			Asthma	
MEDCOM Project:	FY00-0148						
Database Source:	Pub Med						
Database Title:	TM1999						
Search Strategy:	DemoB_FY00_0148-02						

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:	3/27/2003	Keyword				Chronic Disease	
TIAC Program Task:	Demo B	Keyword	x			Asthma	
MEDCOM Project:	FY00-0148						
Database Source:	Pub Med						
Database Title:	TM2000						
Search Strategy:	DemoB_FY00_0148-03						

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:							
TIAC Program Task:							
MEDCOM Project:							
Database Source:							
Database Title:							
Search Strategy:							

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

Date:	3/26/2003
TIAC Program Task:	Demo B
MEDCOM Project:	FY00-0178
Database Source:	Pub Med
Database Title:	TM1999
Search Strategy:	DemoB_FY00_0178-01

Search Strategy Structure

Field	Connector			Parameter	*
	AND	OR	NOT		x
Keyword				Psychiatry	
Keyword	x			Cost and Cost Analysis	

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

Date:	3/26/2003
TIAC Program Task:	Demo B
MEDCOM Project:	Pub Med
Database Source:	TM1999
Database Title:	DemoB_FY00_0178-02
Search Strategy:	

Search Strategy Structure

Field	Connector			Parameter	*
	AND	OR	NOT		x
Keyword	x			Utilization	

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

Date:	3/26/2003
TIAC Program Task:	Demo B
MEDCOM Project:	FY00-0178
Database Source:	Pub Med
Database Title:	TM2000
Search Strategy:	DemoB_FY00_0178-03

Search Strategy Structure

Field	Connector			Parameter	*
	AND	OR	NOT		x
Keyword				Psychiatry	
Keyword	x			Pilot Projects	

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

Date:	3/26/2003
TIAC Program Task:	Demo B
MEDCOM Project:	FY00-0178
Database Source:	Pub Med
Database Title:	TM2000
Search Strategy:	DemoB_FY00_0178-04

Search Strategy Structure

Field	Connector			Parameter	*
	AND	OR	NOT		x
Keyword				Psychiatry	
Keyword	x			Utilization	

* Search parameters used.

FY00-0179

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:	3/12/2003	Keyword				Cardiology	
TIAC Program Task:	Demo B	Keyword	x			Echocardiography	
MEDCOM Project:	FY00-0179						
Database Source:	Pub Med						
Database Title:	TM1999						
Search Strategy:	DemoB_FY00_0179-01						

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:	3/12/2003						
TIAC Program Task:	Demo B						
MEDCOM Project:	FY00-0179						
Database Source:	Pub Med						
Database Title:							
Search Strategy:							

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:	3/12/2003						
TIAC Program Task:	Demo B						
MEDCOM Project:	FY00-0179						
Database Source:	Pub Med						
Database Title:							
Search Strategy:							

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:	3/12/2003						
TIAC Program Task:	Demo B						
MEDCOM Project:	FY00-0179						
Database Source:	Pub Med						
Database Title:							
Search Strategy:							

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:	3/21/2003	Keyword				Administration & Dosage	
TIAC Program Task:	Demo B	Keyword	x			Anticoagulants	
MEDCOM Project:	FY00-0211						
Database Source:	Pub Med						
Database Title:	TM1999						
Search Strategy:	DemoB_FY00_0211-01						

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:	3/21/2003	Keyword				Administration & Dosage	
TIAC Program Task:	Demo B	Keyword	x			Anticoagulants	
MEDCOM Project:	FY00-0211						
Database Source:	Pub Med						
Database Title:	TM2000						
Search Strategy:	DemoB_FY00_0211-02						

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:	3/21/2003						
TIAC Program Task:	Demo B						
MEDCOM Project:							
Database Source:							
Database Title:							
Search Strategy:							

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:	3/21/2003						
TIAC Program Task:	Demo B						
MEDCOM Project:							
Database Source:							
Database Title:							
Search Strategy:							

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:	3/26/2003	Keyword				Decision Support System, Clinical	
TIAC Program Task:	Demo B	Keyword	x			Disasters	
MEDCOM Project:	FY00-0221						
Database Source:	Pub Med						
Database Title:	TM1999						
Search Strategy:	DemoB_FY00_0221-01						

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:	3/26/2003	Keyword				Decision Support System, Clinical	
TIAC Program Task:	Demo B	Keyword	x			Ambulances	
MEDCOM Project:	FY00-0221						
Database Source:	Pub Med						
Database Title:	TM2000						
Search Strategy:	DemoB_FY00_0221-02						

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:	3/26/2003	Keyword				Disaster Planning	
TIAC Program Task:	Demo B	Keyword	x			Med. Records Sys.,Computerized	
MEDCOM Project:	FY00-0221						
Database Source:	Pub Med						
Database Title:	TM1999						
Search Strategy:	DemoB_FY00_0221-03						

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:	3/26/2003						
TIAC Program Task:	Demo B						
MEDCOM Project:	FY00-0221						
Database Source:	Pub Med						
Database Title:							
Search Strategy:							

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:	3/26/2003	Keyword				Neoplasms	
TIAC Program Task:	Demo B	Keyword	x			Patient Care Team	
MEDCOM Project:	FY00-0255						
Database Source:	Pub Med						
Database Title:	TM1999						
Search Strategy:	DemoB_FY00_0255-01						

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:	3/26/2003	Keyword				Neoplasms	
TIAC Program Task:	Demo B	Keyword	x			Rural Health Services	
MEDCOM Project:	FY00-0255						
Database Source:	Pub Med						
Database Title:	TM1999						
Search Strategy:	DemoB_FY00_0255-02						

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:	3/26/2003	Keyword				Neoplasms	
TIAC Program Task:	Demo B	Keyword	x			Patient Care Team	
MEDCOM Project:	FY00-0255						
Database Source:	Pub Med						
Database Title:	TM2000						
Search Strategy:	DemoB_FY00_0255-03						

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:	3/26/2003	Keyword				Neoplasms	
TIAC Program Task:	Demo B	Keyword	x			Rural Health Services	
MEDCOM Project:	FY00-0255						
Database Source:	Pub Med						
Database Title:	TM2000						
Search Strategy:	DemoB_FY00_0255-04						

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:	3/12/2003	Keyword				Ophthalmology	
TIAC Program Task:	Demo B	Keyword	x			Image Proc, Comp Assist	
MEDCOM Project:	FY00-0268						
Database Source:	Pub Med						
Database Title:	TM1999						
Search Strategy:	DemoB_FY00_0268-01						

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:	3/12/2003	Keyword				Ophthalmology	
TIAC Program Task:	Demo B	Keyword	x			Diagnosis	
MEDCOM Project:	FY00-0268	Keyword	x			Image Proc, Comp Assist	
Database Source:	Pub Med						
Database Title:	TM1999						
Search Strategy:	DemoB_FY00_0268-02						

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:	3/12/2003						
TIAC Program Task:	Demo B						
MEDCOM Project:	FY00-0268						
Database Source:	Pub Med						
Database Title:							
Search Strategy:							

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:	3/12/2003						
TIAC Program Task:	Demo B						
MEDCOM Project:	FY00-0268						
Database Source:	Pub Med						
Database Title:							
Search Strategy:							

* Search parameters used.

FY01 MEDCOM Projects

FY01-0040

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:	3/12/03	Keyword				Cerebrovascular Accident	
TIAC Program Task:	Demo B						
MEDCOM Project:	FY01-0040						
Database Source:	Pub Med						
Database Title:	TM1999						
Search Strategy:	DemoB_FY01_0040-01						

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:	3/12/03						
TIAC Program Task:	Demo B						
MEDCOM Project:	FY01-0040						
Database Source:	Pub Med						
Database Title:							
Search Strategy:							

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:	3/12/03						
TIAC Program Task:	Demo B						
MEDCOM Project:	FY01-0040						
Database Source:	Pub Med						
Database Title:							
Search Strategy:							

* Search parameters used.

TIAC BIBLIOGRAPHIC SEARCH SPECS

		Search Strategy Structure					
		Field	Connector			Parameter	*
			AND	OR	NOT		x
Date:	3/12/03						
TIAC Program Task:	Demo B						
MEDCOM Project:	FY01-0040						
Database Source:	Pub Med						
Database Title:							
Search Strategy:							

* Search parameters used.